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*Francis Glisson*

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**American Academy of Orthopaedic Surgeons**
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*The Journal of Bone and Joint Surgery* is the official publication of orthopaedic surgeons of the Commonwealth of British Nations and the United States of America, and in this respect it represents the science and practice of orthopaedic surgery in the English-speaking world; but important orthopaedic contributions are also reported from every country in the world, and original articles will be welcomed from any contributor, wherever he may live. Facilities for translation will be made available.

We are also anxious to report the Proceedings of Colleges, Universities, Societies and Associations in every part of the world in so far as they contribute to the advance of orthopaedic surgery. A measure of international co-operation in publication has already been achieved and this will be fostered and, we hope, increased.

Manuscripts offered for publication in the British volume should be addressed to the Editor, Journal of Bone and Joint Surgery, Ludgate House, Fleet Street, London. The Editorial Secretary of the Board is at the service of authors, and will assist in any way she can. Manuscripts offered for publication in the American volume should be addressed to the Editor, Journal of Bone and Joint Surgery, 8 The Fenway, Boston 15, Massachusetts.

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The names of Journals should be given in full; it is not proposed to adopt the "World List" of abbreviations. Every bibliography and list of references will be checked by the Editor, but much delay will be avoided if authors would be good enough to pay careful attention to accuracy.

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The Journal of
Bone and Joint Surgery

## EDITORIAL

### TRAUMATIC ULNAR NEURITIS

On February 13, 1887, before the Académie de Médecine in Paris, Dr Panas described four cases in which a slowly progressive lesion of the ulnar nerve was associated with a bony abnormality of the elbow; this is probably the earliest account of traumatic ulnar neuritis. In three of Panas's patients, it is interesting to note that the etiological factors present—old fracture of the lower end of the humerus, hypertrophic osteoarthritis, and an abnormally shallow ulnar groove—are representative of the three chief groups described by later writers.

The descriptive term "traumatic ulnar neuritis" conveys as true a picture of the pathology as the very limited histological evidence permits. No one during the last seventy years has given a fuller account of the intraneural changes taking place than did Panas in his original presentation. This is due to the rarity with which—very properly—resection of the lesion has been done; however, the simple conception that repeated injury gives rise to hyperaemia, oedema and slow infiltration by fibrous tissue may well be correct. It is strikingly apparent that in cubitus valgus, whether congenital or the result of injury early in life, symptoms frequently do not appear for twenty years, although after a similar deformity developing in adult life the latent period is much shorter.

At one time operative treatment included supracondylar osteotomy to correct a cubitus valgus, or gouging out the ulnar groove in order to shorten the course of the nerve. Anterior transposition of the nerve is now the universal and more satisfactory practice. Whatever the underlying cause, it is a simple and logical procedure to remove the nerve out of harm's way.

In this issue Miss A. J. McGowan analyses the etiological factors responsible for the lesion. Unlike earlier workers, she has found that the lesion was post-traumatic in less than half the cases. The next most frequent cause was osteoarthritis of the elbow joint, and there followed a group of cases in which the etiology was doubtful and which must be termed idiopathic. The insidious nature of the pathological process is manifested by the comparatively short duration of symptoms in most cases, though clinical examination shows that the paresis is by no means recent. As might be expected in McGowan's Grade III lesions, where there was actual paralysis of some or all of the intrinsic muscles, recovery judged by motor function was poor, yet in all but one of these cases full sensibility was regained even to the extent of normal two-point discrimination.

Recovery after anterior transposition of the nerve depends largely on two factors: the reversibility of the changes that have taken place at the site of irritation, and the reversibility of the changes present in the motor and sensory end-organs and muscles. That the intraneural changes present in the lesion are to a great extent capable of resolution is suggested by the good quality of sensory recovery; furthermore, this recovery provides strong evidence that

regeneration of sensory end-organs can take place. In muscle which has been denervated for more than eighteen months it is known that secondary changes occur which consist essentially of a fibrous replacement of contractile tissue. The consequence is that even in the presence of axonal regeneration, recovery of function may be impossible; in cases in which severe muscle atrophy was present pre-operatively this is an important factor.

It is clear that early transposition of the nerve is desirable; there is no conservative treatment. With regard to operative technique it has become apparent that, although anterior transposition superficial to the flexor mass is often successful, symptoms can recur from kinking of the nerve as it dives beneath the deep fascia in the forearm. The nerve should be buried beneath the whole mass of the flexor muscles; and the medial supracondylar septum must always be excised, for the nerve may be caught over its sharp edge. By these means good results can be obtained consistently. Excision of the medial epicondyle—a procedure favoured by King and Morgan of Melbourne—can be reserved for use in special circumstances.

DONAL M. BROOKS.

# THE RESULTS OF TRANSPOSITION OF THE ULNAR NERVE FOR TRAUMATIC ULNAR NEURITIS

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Recent reports on the etiology, diagnosis and treatment of traumatic ulnar neuritis and tardy paralysis of the ulnar nerve have been published by Richards (1945) and by Gay and Love (1947). The present report is based on a detailed analysis of the results of transposition in forty-six cases with post-operative observation varying from one to five years. A further six cases of technically faulty transposition are discussed.

*Clinical material*—Between 1941 and 1946 forty-six patients were admitted to the Peripheral Nerve Injuries Unit with "traumatic ulnar neuritis." This term, which is not wholly satisfactory, was used to embrace those cases in which a progressive lesion involved the ulnar nerve behind the medial epicondyle. Direct irritation from friction in a roughened groove, inadequate protection from repeated mild trauma, and stretching of the nerve trunk were the main exciting causes.

The identification of the site of the nerve lesion was straightforward in most cases. In traumatic ulnar neuritis, however, there is a tendency for the interossei to be affected with sparing of the proximal muscles, and the slight blunting of sensibility may be difficult to detect. The clinical picture may therefore be confused with that produced by compression of the deep branch of the ulnar nerve in the palm, an uncommon condition described by Harris in 1929 and again by Russell and Whitty in 1947.

The cases were classified as follows: post-traumatic or tardy ulnar palsy, 21 cases; arthritis of the elbow joint with no history of fracture, 10 cases; recurrent dislocation of the ulnar nerve, 3 cases; congenital cubitus valgus, 2 cases; local scarring, 3 cases; etiology doubtful, 7 cases. The severity of the lesions varied considerably and was independent of the etiology. In order to assess the benefit derived from operation, the cases have been graded according to the severity of the nerve involvement at the time of operation:

Grade I — Minimal lesions, with no detectable motor weakness of the hand.

Grade II — Intermediate lesions.

Grade III—Severe lesions, with paralysis of one or more of the ulnar intrinsic muscles.

## ANALYSIS OF CASES

**Previous fracture.** *Cases T.1 to T.21.*—In twenty-one cases the lesion had developed after a fracture of the lower end of the humerus or of the forearm near the elbow. (See Tables I and II.) Though in twelve of these twenty-one patients the interval between the fracture and the onset of symptoms was more than twenty years, none approached the record of fifty-nine years recorded by Mouchet and Seillé in 1949.

**Idiopathic osteoarthritis.** *Cases A.22 to A.31.*—Eight of the ten patients were manual workers and nine were men; none gave a history of previous fracture or severe injury to the arm. All were right-handed, and the right side was affected in eight of the ten cases. The age at the onset of symptoms varied from forty-seven to sixty-four years.

In six patients the onset was rapid; three of these developed symptoms while they were confined to bed with another illness, two patients dated the onset from a slight knock on the elbow and the sixth noticed the onset of tingling while walking in the street.

Pain and tingling were early and prominent features in seven patients, causing them to

TABLE I

TWENTY-ONE CASES OF PREVIOUS FRACTURE

| Age at time of fracture | Number of cases | Type of fracture | | Average latent period |
|---|---|---|---|---|
| Under 11 years | 8 | Supracondylar<br>Forearm | 7<br>1 | 29 years<br>(20 *min.*, 40 *max.*) |
| 11–20 years | 6 | Elbow<br>Forearm | 5<br>1 | 22 years<br>(3 *min.*, 30 *max.*) |
| 21–30 years | 6 | Elbow | 6 | 8 years |
| 31 years and over | 1 | Medialepicondyle | 1 | 5 years |

TABLE II

CONDITION OF THE ELBOW IN TWENTY-ONE CASES OF PREVIOUS FRACTURE

| Radiographic findings | Number of cases | Clinical findings | | |
|---|---|---|---|---|
| | | Fixed flexion deformity | Increased carrying-angle | Roughened ulnar groove |
| Malunion of medial epicondyle . . . . | 5 | 3 | 2 | 5 |
| Non-union or malunion of lateral epicondyle and capitellum . . . . | 5 | 3 | 5 | 1 |
| Chip fracture of medial epicondyle with roughened ulnar groove . . . | 3 | 3 | 2 | 3 |
| Disorganised joint . . | 2 | 2 | 1 | 2 |
| Increased carrying-angle . | 2 | 1 | 2 | 0 |
| Radiographs not available | 4 | 4 | 3 | 4 |
| Totals . . . | 21 | 16 | 15 | 15 |

seek advice within a few months. Yet all seven showed very marked wasting of the interossei, which may be explained either by rapid advance of the lesion (Richards 1945), or by a gradual weakness having remained unnoticed until the onset of sensory disturbance.

In four cases bony irregularities were present in the ulnar groove, and in three the groove was occupied by a cystic swelling. In the remaining cases the groove was shallow and roughened.

**Recurrent dislocation of the ulnar nerve.** *Cases D.32 to D.34.*—In two of the three cases the recurrent dislocation was complete. All three patients attended hospital early complaining chiefly of discomfort in the region of the elbow, and in each case the neuritis was mild (*cf.*, Cobb 1908).

**Cubitus valgus.** *Cases C.35* to *C.36.*—In two cases there was congenital cubitus valgus and anterior dislocation of the head of the radius. In both patients the carrying-angle was increased to 25 or 30 degrees; extension of the elbow joint was limited; the ulnar groove was shallow, with the ulnar nerve stretched over a crest of bone at its distal end. One patient aged sixty-two years developed a severe neuritis in the course of a few weeks; a firm neuroma three centimetres in length was present, and it became apparent later that the nerve had suffered permanent damage. In the other patient a trivial knock on the elbow at the age of twenty-six years was immediately followed by pain spreading to the fifth digit and by muscular weakness, which led to early diagnosis; transposition of the ulnar nerve gave complete relief.

**Scarring.** *Cases S.37 to S.39.*—Laceration of the soft tissues near the medial epicondyle can lead to involvement of the ulnar nerve either by gradual scar compression or by tethering of the nerve so that its mobility is hindered. Such local scarring was present in three patients who had sustained lacerations two months, three years and four years respectively before the onset of the neuritis.

**Other causes.** *Cases O.40 to O.46.*—In seven cases no mechanical abnormality of the elbow joint was found. The work of two patients, one a sheet-metal worker and the other a coach-builder, required much hammering. The third patient, a student aged twenty-three years, had the habit of sitting for many hours with her head on the left hand and the elbow pressed against the table. In the remaining four patients, all women, some form of housework might have been a cause of the condition.

## TECHNIQUE OF TRANSPOSITION

In forty-two cases the nerve was transposed *superficial* to the flexor muscles after adequate mobilisation of the nerve and resection of the medial intermuscular septum in order to free the course from sharp angles. In twenty-five of these it was laid on the superficial surface of the deep fascia and there was no tendency for the nerve to slip back to its former position; a silk stitch between the superficial and deep fascia anterior to the medial epicondyle was used, however, as an added safeguard (Fig. 1). In the remaining seventeen cases a shallow groove was cut on the surface of the flexor muscles and the nerve trunk was laid within it.

Transposition of the ulnar nerve to these superficial positions was, however, avoided in patients with little subcutaneous fat, with scarring on the antero-medial aspect of the elbow, and also in those patients with a tender neuroma. In four cases the nerve was accordingly transposed to a bed *deep* to the flexor muscles.

It may here be noted that six patients were referred to the Unit with symptoms persisting despite transposition of the nerve undertaken elsewhere. In one case transposition had failed completely and the nerve had slipped back into the ulnar groove; in the other five, inadequate mobilisation of the nerve trunk had caused sharp angulation and some constriction 1·0 to 2·5 centimetres below the medial epicondyle. All six patients were relieved by free mobilisation of the nerve and replacement *deep* to the flexor origin.

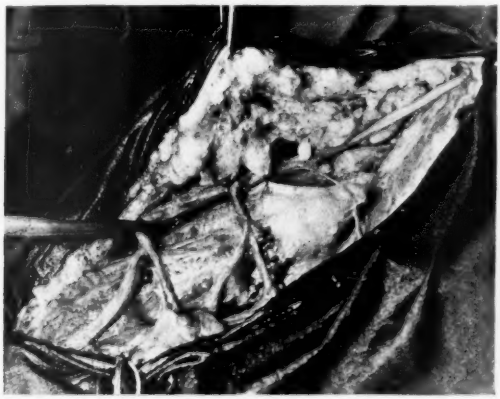

FIG. 1

To illustrate the technique of transposition most frequently used in this series. The ulnar nerve is superficial to the deep fascia, and a silk stitch has been inserted between the superficial and the deep fascia to prevent the nerve from slipping back over the epicondyle.

## ASSESSMENT OF RECOVERY

**Grade I. Minimal lesions**—There were six cases (Table III). The symptoms were paraesthesiae in the ulnar area and a feeling of clumsiness in the affected hand. Examination revealed no wasting or weakness of the ulnar intrinsic muscles. There was slight blunting of sensation, and stroking the skin produced a tingling sensation. In two cases the sweating test revealed a slight but definite hyperhidrosis of the ulnar area. The underlying causes were old fractures of the elbow joint in four cases and recurrent dislocation of the ulnar nerve in two cases.

At operation the ulnar nerves were found to be of normal size and consistency. In one case the nerve trunk was slightly flattened and in three of the post-traumatic cases adhesions were present in the ulnar groove.

*Results*—In every case the patient stated that the " pins and needles " and discomfort were relieved immediately after the operation, even when symptoms had been present for as long as ten years. Two patients also felt an improvement in the strength of grip, although this could not be detected clinically. The six patients were observed for one or two years, when there was no recurrence of symptoms and the neurological examinations were negative. The only complaint came from one patient who said the fifth digit was blue in cold weather.

**Grade II. Intermediate lesions**—There were twenty-seven cases (Table IV). Pre-operatively the interossei were weak, and wasting was usually obvious; but some voluntary power was retained. The causative mechanism varied and all the etiological groups previously described were represented. In assessing the motor involvement it was apparent that the interossei were frequently more severely affected than the hypothenar or proximal muscles, and the grading of the interossei has therefore been used in Table IV to indicate the severity of the lesion.

The sensory disturbance amounted to anaesthesia and analgesia in only six cases. Blunting of sensibility was present in the remainder except in two patients in whom normal sensibility was accompanied by tingling. Sweating was always preserved; in the seventeen patients in whom the sweating of the hands was compared, hyperhidrosis was present in eight.

At operation a fusiform neuroma was found in eleven cases, and in four of these the nerve was adherent to the groove. In eight cases the nerve was swollen, fibrous adhesions being present in five. In a further two cases the nerve trunk was compressed by scar tissue. The remaining six cases showed no gross abnormality. In only four cases was the lesion firmer in consistence than the normal nerve.

*Results*—Twenty-two of the twenty-seven patients noticed some improvement in the hand within the first two weeks after operation. Relief of the paraesthesia and pain occurred in twelve and the other ten noticed improvement in either the motor or sensory function.

Post-operative observation of some patients was continued for as long as five years. The recovery of muscle power was good: no residual weakness could be detected in eleven of the twenty-seven cases. In all but two of the remainder, the muscles could act against gravity and resistance. The two exceptions were: Case S.39, in which the ulnar neuritis developed after a local injury with shot and in which division of some fibres was probable; and Case D.32, in which the first dorsal interosseous remained weak although the other muscles had regained full power. Wasting of the muscles was usually not pronounced, but was still obvious in two cases, T.14 and A.29, at the final examination.

The relief from the troublesome discomfort associated with ulnar neuritis was excellent, being complete in all except three patients. Two of these complained of a little residual aching in cold weather and the third had pain in the operation scar with local tenderness. No significantly abnormal sensibility could be detected in twenty patients, using two-point discrimination, figure writing on the finger, and appreciation of surfaces as well as the von Frey's hair and pinprick. In the seven cases in which the sensibility was not quite normal, hypoaesthesia was detected with the 0·5 gram hair in six cases; two-point discrimination was less accurate than on the normal side in five.

The function of the hand was excellent in all except Case T.11, a Service patient with pain in the operation scar who refused further treatment and declared that the hand was numb and useless; little clinical abnormality, however, could be detected. All the other patients returned to their original work and suffered no noticeable disability from the affected hand. Two patients were unable to do heavy work with the arm because of the underlying abnormality of the elbow joint. Nearly all the patients were very pleased with their progress, describing their hands as excellent or quite normal.

**Grade III. Severe lesions**—There were thirteen patients (Table V). Pre-operatively, the interossei were paralysed, with marked weakness of the hand. The cause was always a mechanical derangement of the elbow joint of post-traumatic, arthritic or congenital origin.

Although all thirteen had paralysis and severe wasting of the interossei, weak voluntary power was retained in the first dorsal interosseous muscle in four cases. In contrast with the interossei, the hypothenar muscles were found to act against gravity and resistance in eight cases; flexor carpi ulnaris was normal in nine; and the ulnar half of flexor digitorum profundus was of nearly full power in all thirteen.

In seven cases there was complete anaesthesia and analgesia in the ulnar area. Hypoaesthesia was marked in all the remainder except Case T.5. In no case was there complete loss of sweating. Hyperhidrosis was present in six of the eight patients examined by sweating test.

At operation there was a fusiform neuroma or swollen nerve trunk in all thirteen, except Case A.24, in which the nerve was surrounded and compressed by adhesions. The lengths of the neuroma varied from 1 centimetre to 3·5 centimetres: in Case C.35 the neuroma was unusually firm.

*Results*—No motor improvement was observed in the early post-operative period. Observation was continued for one to four years; although some voluntary power returned to the previously paralysed interossei in every case, in only one (Case T.8) was the motor recovery complete. In three cases the muscles were acting against gravity and resistance, in six against gravity and slight resistance, but in three the first dorsal was the only interosseous muscle to regain the power of acting against gravity—with no more than an ineffective flicker in the remaining ulnar intrinsic muscles. This weakness of the interossei was associated with a poor grip and difficulty in performing independent movements of the digits. In five of the cases, wasting of the muscles was still pronounced at the final examination.

Improvement in sensibility was noted by six patients soon after the operation, and the two with paraesthesiae were relieved. The final sensory recovery was good and ten of the thirteen patients regained normal sensation. In a further two, although there was slight hypoaesthesia, two-point discrimination was accurate. The patient in whom the neuroma was noted to be of firm consistence at operation (Case C.35) did not recover so well; slight hypoaesthesia persisted and two-point discrimination was 10 millimetres compared with 4 millimetres on the unaffected side.

The patients all resumed their original occupations. The return of function to the hand was surprisingly good: one patient played the piano, and a housewife found that she was able to knit again. Four patients in this group stated that the hand felt normal; two found that in cold weather it was clumsy and felt stiff; all the others said that the hand was very much stronger than before the operation, but, in the words of one patient, " it was less nimble than the good hand."

## DISCUSSION

It has generally been assumed that " traumatic ulnar neuritis," if left untreated, is a persistent and progressive lesion. During this survey one patient was seen in whom the tentative diagnosis was made but who recovered without operation. The patient was a labourer aged forty-five years. While pushing a heavy load he " felt something go " in the

TABLE III—MINIMAL LESIONS (GRADE I)

| Etiology | Case | Sex | Age | Side | Occupation | Duration of symptoms | Condition before operation | | | | State of nerve at operation | Follow-up (*years*) | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pain and tingling | Motor | Sensory | Sweating | | | |
| Post-traumatic | T.16 | F | 20 | L | Wire coil winder | 3 years | + | Normal | Normal | Normal | Normal but adherent | 2 | Normal |
| Post-traumatic | T.17 | M | 48 | L | 1) Engineer 2) Army | 2 years | + | Normal | Slight hypo-aesthesia | + | Flattened and compressed | 1 | Vascular spasm fifth digit in cold weather |
| Post-traumatic | T.18 | M | 35 | L | 1) Warehouseman 2) Army | 10 years | + | Normal | Normal | Normal | Normal but adherent | 2 | Normal |
| Post-traumatic | T.19 | F | 49 | R | Housewife | 1 year | + | Normal | Hypo-aesthesia | Normal | Normal but adherent | 2 | Normal |
| Recurrent dislocation | D.33 | M | 41 | R | Army | 4 months | + | 4½–5 | Hypo-aesthesia | + | Normal | 1 | Normal |
| Recurrent dislocation | D.34 | F | 46 | R | Housewife | 1 month | + | Normal | Normal | — | Normal | 2 | Normal |

*Motor power of the interossei is assessed according to the Medical Research Council grading.*
*+ indicates pain and tingling, or hyperhidrosis.* *— indicates hypohidrosis.*

TABLE IV—INTERMEDIATE LESIONS (GRADE II)

| Etiology | Case | Sex | Age | Side | Occupation | Duration of symptoms | Condition before operation | | | | | State of nerve at operation | Follow-up (*years*) | Result | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pain | Wasting | Motor | Sensory | Sweating | | | Pain | Wasting | Motor | Sensory | T.P.D. |
| Post-traumatic | T.4 | F | 23 | L | Housewife | 3 months | | + | 2 | Hypo-aesthesia | — | Neuroma, adherent | 2 | | | Normal | Normal | Normal |
| Post-traumatic | T.9 | M | 35 | R | 1) Policeman 2) Army | 3 years | | | 4 | O | + | Swollen, adherent | 1 | | | Normal | Normal | Normal |
| Post-traumatic | T.10 | M | 24 | R | 1) Accountant 2) Army | 6 months | + | + | 4½ | O | + | Neuroma | 5 | | | Normal | Normal | Normal |
| Post-traumatic | T.11 | M | 27 | R | 1) Hairdresser 2) R.A.F. | 2 months | + | | 4½ | Hypo-aesthesia | N.T. | Swollen, adherent | 1 | Painful scar | | 4 | Hypo-aesthesia | 8 mm. |
| Post-traumatic | T.12 | M | 30 | L | 1)Cabinet maker 2)Army | 2 years | + | + | 2 | Hypo-aesthesia | + | Swollen, adherent | 1½ | | | 4 | Normal | Normal |
| Post-traumatic | T.13 | M | 46 | L | Army officer | 9 months | + | + | 3 | Hypo-aesthesia | N.T. | Neuroma | 2 | | | 4½ | Normal | Normal |
| Post-traumatic | T.14 | F | 30 | R | Tool-grinder | 1 year | | + | 2 | Hypo-aesthesia | Normal | Neuroma, adherent | 4½ | | + | 4 | Normal | Normal |
| Post-traumatic | T.15 | F | 33 | R | Housewife | 3 months | + | + | 3–4 | Hypo-aesthesia | N.T. | Swollen, adherent | 1 | | | 4 | Normal | Normal |
| Post-traumatic | T.20 | M | 23 | L | R.A.F. | 2 months | + | | 4 | Hypo-aesthesia | + | Neuroma | 1 | | | 4½ | Normal | Normal |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arthritis | A.26 | M | 61 | L | Farm labourer | 2 months | + | + | 2½ | O | N.T. | Compressed | 5 | | | 4 | Normal | Normal |
| Arthritis | A.27 | M | 58 | R | Slaughterer | 2 months | + | + | 1½ | Hypo-aesthesia | N.T. | Swollen, adherent | 1 | | | 4 | Normal | Normal |
| Arthritis | A.28 | F | 55 | R | Housewife | 1 year | + | + | 2 | Hypo-aesthesia | Normal | Neuroma | 2½ | | | 4 | Normal | Normal |
| Arthritis | A.29 | M | 64 | R | Insurance agent | 3 months | + | + | 3 | O | N.T. | Neuroma, adherent | 3 | | + | 4½ | Hypo-aesthesia | Normal |
| Arthritis | A.30 | M | 47 | R | Garage hand | 1¼ years | | | 4½ | Hypo-aesthesia | Normal | Normal | 2 | | | Normal | Normal | Normal |
| Arthritis | A.31 | M | 53 | L | Solicitor | 6 months | + | + | 1 | Hypo-aesthesia | – | Compressed | 3 | Ache | | Normal | Normal | In-accurate |
| Recurrent dislocation | D.32 | M | 38 | L | Army | 1½ years | + | + | 2½ | Hypo-aesthesia | + | Swollen | 2 | | | 3–5 | Normal | Normal |
| Congenital cubitus valgus | C.36 | M | 26 | L | 1) Student 2) R.A.F. | 2 months | + | + | 2 | Hypo-aesthesia | N.T. | Normal | ½ | | | Normal | Normal | Normal |
| Local scarring | S.37 | F | 23 | L | W.A.A.F. | 1 year | | + | 3 | Hypo-aesthesia | + | Swollen | 2½ | | | 4½ | Normal | Normal |
| Local scarring | S.38 | M | 51 | R | Time-keeper | 9 months | + | + | 3 | Hypo-aesthesia | – | Neuroma | 4 | | | 4 | Hypo-aesthesia | Normal |
| Local scarring | S.39 | M | 56 | R | 1) Game-keeper 2) R.A.F. | 3 years | + | | 2–3 | Hypo-aesthesia | Normal | Normal but F.B. in contact | 2 | | | 2–3 | Hypo-aesthesia | 23 mm. |
| Doubtful | O.40 | M | 60 | R | Sheet-metal worker | 2 years | + | + | 1–3 | Hypo-aesthesia | + | Neuroma | 2 | Ache | | 4½ | Normal | Normal |
| Doubtful | O.41 | F | 23 | L | Student | 2 months | + | + | 3 | Hypo-aesthesia | + | Normal | 1½ | | | Normal | Normal | Normal |
| Doubtful | O.42 | F | 46 | R | Housewife | 10 months | + | + | 1–2 | Normal | N.T. | Swollen | 1 | | | Normal | Normal | Normal |
| Doubtful | O.43 | F | 51 | R | Housewife | 1¼ years | + | | 4 | Normal | – | Neuroma, adherent | 3 | | | Normal | Normal | Normal |
| Doubtful | O.44 | M | 49 | R | Coach-builder | 9 months | + | + | 3 | Hypo-aesthesia | Normal | Neuroma | 2½ | | | 4 | Normal | Normal |
| Doubtful | O.45 | F | 28 | R | W.A.A.F. | 8 months | | + | 2 | O | N.T. | Normal | 2 | | | Normal | Hypo-aesthesia | 16 mm. |
| Doubtful | O.46 | F | 28 | L | W.A.A.F. | 8 months | | + | 2 | O | N.T. | Normal | 2 | | | Normal | Hypo-aesthesia | 14 mm. |

*Motor power of the interossei is assessed according to the Medical Research Council grading.*

*+ indicates pain and tingling, wasting, or hyperhidrosis.* *O indicates paralysis of the interossei, or anaesthesia and analgesia.* *– indicates hypohidrosis.*

*N.T. indicates that a comparative sweating test was not done.* *T.P.D. indicates two-point discrimination.*

TABLE V

SEVERE LESIONS (GRADE III)

| Etiology | Case | Sex | Age | Side | Occupation | Duration of symptoms | Condition before operation | | | | | State of nerve at operation | Follow-up (*years*) | Result | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Pain | Wasting | Motor | Sensory | Sweating | | | Pain | Wasting | Motor | Sensory | T.P.D. |
| Post-traumatic | T.1 | M | 40 | L | Army officer | 8 months | | + | O | O | + | Neuroma | 2 | | + | 3 | Hypo-aesthesia | Normal |
| Post-traumatic | T.2 | M | 41 | L | 1) Machine fitter 2) Army | 10 months | | + | O | O | + | Neuroma | 1½ | | + | 3½ | Normal | Normal |
| Post-traumatic | T.3 | F | 38 | L | Housewife | 1½ years | | + | O | Hypo-aesthesia | — | Neuroma | 3 | | | 3½–4 | Normal | Normal |
| Post-traumatic | T.5 | M | 46 | R | Rose grower | 2 years | | + | O | Normal | Normal | Swollen | 2½ | | | 4–5 | Normal | Normal |
| Post-traumatic | T.6 | F | 53 | R | Dressmaker | 3 years | | + | O | Hypo-aesthesia | N.T. | Neuroma | 2½ | | | 4 | Normal | Normal |
| Post-traumatic | T.7 | M | 40 | L | 1) Fitter 2) R.A.F. | 1 year | | + | O | Hypo-aesthesia | N.T. | Swollen | 1 | | | 2–4 | Normal | Normal |
| Post-traumatic | T.8 | F | 30 | R | Housewife | 8 months | | + | O | Hypo-aesthesia | + | Neuroma | 2 | | | Normal | Normal | Normal |
| Post-traumatic | T.21 | M | 30 | R | 1) Boiler-maker 2) Army | 10 months | | + | O | O | + | Neuroma | 3 | Aches | | 3–4 | Normal | Normal |
| Arthritis | A.22 | M | 54 | R | Transport driver | 4 months | + | + | O | O | + | Neuroma | 4½ | Aches | + | 1½–3 | Hypo-aesthesia | Normal |
| Arthritis | A.23 | M | 47 | R | Van driver | 3 months | | + | O | Hypo-aesthesia | + | Neuroma | 2 | | | 4½ | Normal | Normal |
| Arthritis | A.24 | M | 49 | R | Farm labourer | 3 months | + | + | O | O | N.T. | Normal, adherent | 1½ | | + | 3½ | Normal | Normal |
| Arthritis | A.25 | M | 60 | R | Engineer | 1 year | | + | O | O | N.T. | Neuroma | 3 | | | 3½–4 | Normal | Normal |
| Congenital cubitus valgus | C.35 | M | 62 | R | 1) Warehouse-man 2) R.A.F. | 3 months | | + | O | O | N.T. | Neuroma (firm) | 4 | | + | 2–3 | Hypo-aesthesia | 10 mm. |

*Motor power of the interossei is assessed according to the Medical Research Council grading.*

*+ indicates pain and tingling, wasting, or hyperhidrosis.* O *indicates paralysis of the interossei, or anaesthesia and analgesia.* — *indicates hypohidrosis.*
N.T. *indicates that a comparative sweating test was not done.* T.P.D. *indicates two-point discrimination.*

right elbow region, and immediately a pain spread down the arm to the ulnar area; later he noticed the onset of numbness and weakness, which increased during the next three to four months. He attended hospital four months after the onset; osteoarthritis of the elbow was present and the ulnar groove was roughened; the ulnar nerve was adherent and thought to be thickened. The first dorsal interosseous was paralysed and the remaining intrinsics were acting only against gravity. There was no sensory or sweating loss. Operation was refused, but the patient reported at six-monthly intervals. At the third visit incomplete recovery was observed in the first dorsal interosseous; steady improvement continued and finally, two and a half years after the onset, all the muscles had regained almost full power.

In all the other patients the lesion appeared to be progressive, and transposition of the ulnar nerve was undertaken. When the ulnar neuritis was minimal at the time of operation, relief was complete and full function was regained. In the intermediate group, although the hand became strong, useful and free from discomfort after the operation, slight residual weakness persisted in sixteen of the twenty-seven cases and slight sensory impairment in seven.

In the severe lesions with paralysis of the interossei and gross wasting of the muscles, full recovery of motor function was seldom regained but the improvement amply justified the operation. In all cases the interossei showed some recovery, the function of the hand was much improved and the sensory recovery was good even when anaesthesia and analgesia had been present at the time of the operation.

These results suggest that adequate recovery of motor power can be assured only when transposition is undertaken before the lesion has progressed to paralysis of the muscles; but that even in the most advanced cases significant improvement in motor power can be expected, whilst the relief of discomfort and the sensory recovery are always good.

## SUMMARY

1. The progress of recovery after transposition of the ulnar nerve has been studied in forty-six patients with ulnar neuritis of traumatic or mechanical origin.

2. In assessing the results, the lesions were divided into three grades according to the severity of the neurological signs: Grade I, minimal lesions with no detectable motor weakness; Grade II, intermediate lesions; Grade III, severe lesions with paralysis of one or more of the ulnar intrinsic muscles.

3. The earliest and most constant result after operation was the relief of discomfort and ulnar paraesthesiae.

4. The degree of motor recovery varied according to the severity of the lesion at the time of the operation. In Grades I and II cases, all the muscles (with one exception) were acting against gravity and resistance at the final examination. In Grade III cases, the recovery was usually far from complete. Recovery of sensibility was uniformly good.

5. In a further six patients with persistent symptoms after transposition, relief was obtained by free mobilisation and placing the nerve deep to the flexor origin.

My thanks are due to Professor H. J. Seddon and Mr R. B. Zachary for their encouragement and help, to Dr F. H. Kemp for his opinions on the radiographs, to Mrs M. Crossley for the photograph, and to the members of the Peripheral Nerve Injuries Unit who performed the operations. Part of this work was done in 1947 while the author was in receipt of a grant from the Medical Research Council.

## REFERENCES

Cobb, F. (1908): Annals of Surgery, **48,** 409.
Gay, J. R., and Love, J. Grafton (1947): Journal of Bone and Joint Surgery, **29,** 1087.
Harris, W. (1929): British Medical Journal, **i,** 98.
Mouchet, A., and Seillé, G. (1949): Presse médicale, **57,** 197.
Richards, R. L. (1945): Edinburgh Medical Journal, **N.S. 52,** 14.
Russell, W. Ritchie, and Whitty, C. W. M. (1947): Lancet, **i,** 828.

# JOINT DEBRIDEMENT FOR OSTEOARTHRITIS OF THE KNEE

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" Joint débridement " is a term introduced by Magnuson (1941) to describe an operation on the knee in which all the accessible synovial membrane, osteophytes, diseased cartilage and abnormal soft tissues are removed in an effort to relieve the symptoms of osteoarthritis. Magnuson reported many good results, and Haggart (1947) confirmed the value of the operation; there has been, however, no very wide acceptance. This present paper records the results of thirty-five operations performed on thirty-two patients during the last eight years; the series includes all those patients whom it was possible to trace and examine twelve months or more after their operation.

*Selection of cases*—Experience has shown that it is wise to reserve operation for persistent pain with swelling and moderate instability of the knee, in patients who have not obtained relief from conservative measures. The joint should not be too grossly disorganised, for the aim is to relieve pain and yet preserve useful movement. The patients must be those who are capable of co-operating in the after-treatment, which is quite painful at the time just after operation.

*Technique of operation*—We have modified Magnuson's technique in a few minor respects. A tourniquet is always used, and a medial or lateral parapatellar incision is made according to which side of the knee is more affected (Fig. 1). The patella may be displaced sideways (Fig. 2) or downwards by an inverted **Y** incision in the quadriceps tendon (Coonse and Adams 1943); but in half the cases the patella has to be removed. When removing the synovial membrane, special attention is paid to the part near the edge of the articular surfaces (Figs. 3, 4 and 5). Osteophytes are removed with a chisel (Fig. 6), and loose or worn articular cartilage with a knife. The articular surfaces are finally smoothed with a rasp or file, when even cancellous bone may be left exposed (Fig. 7). The menisci are preserved if they are intact and appear healthy, and the cruciate ligaments are removed only if they are found to be torn. When the patella is preserved, any osteophytes are removed and the articular surface is smoothed. When excision of the patella has been necessary the quadriceps and patellar tendons are firmly sutured with stout thread.

*After-treatment*—The only fixation used after operation is a compression bandage. Quadriceps exercises are begun as soon as possible, and active movements after a few days. Weight can usually be taken on the leg after three weeks. The recovery of flexion may be aided by a cautious manipulation after five or six weeks, but only if the range at that time is less than fifty degrees. The range of movement may be expected to improve for twelve months.

*Complications*—Occasionally a haemarthrosis needs aspiration. One femur was fractured during a manipulation, but there have been no other important complications.

### A TYPICAL CASE

**Case 14.** Mr W. H. C., a man aged sixty-six years, was operated upon in February 1945. The history was short, as he had had severe pain in the right knee for only six months, after a minor injury. Despite regular physiotherapy the pain had increased steadily until he was quite unable to get about. There was a large effusion in the right knee joint, and the quadriceps muscle was very much wasted. Extension was incomplete, and flexion was to the right angle only. A radiograph showed severe arthritic changes with many loose bodies.

FIG. 1
To show the medial parapatellar incision.

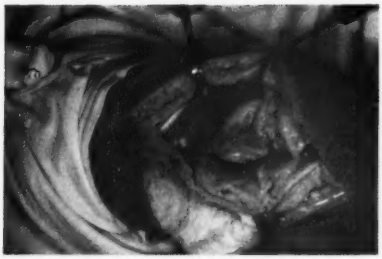

FIG. 2
The patella is displaced laterally.

FIG. 3
The synovial membrane is dissected away. Note the loose bodies.

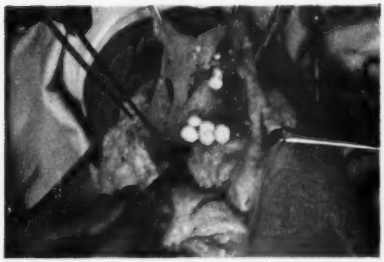

FIG. 4
The dissection at a further stage after removal of the patella.

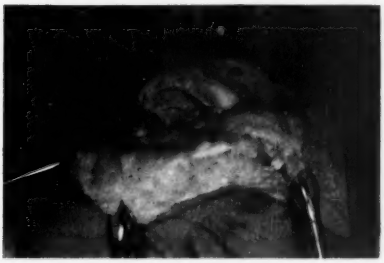

FIG. 5
After synovectomy the diseased articular surfaces are well shown.

FIG. 6
Osteophytes are removed with a chisel.

FIG. 7
The articular surfaces are filed smooth.

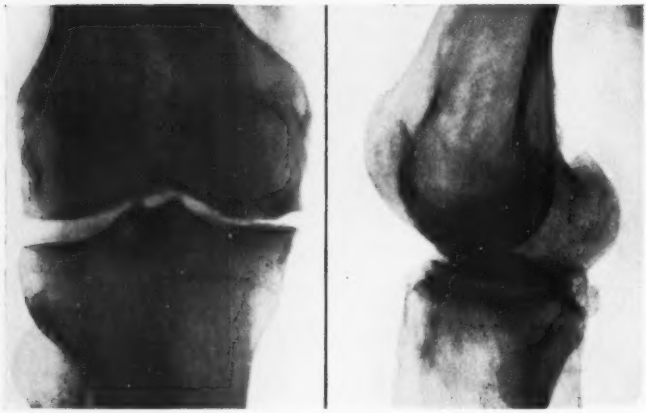

FIG. 8
Case 14—Radiographs five years after joint débridement.

The routine operation included removal of the patella. Three months later the range of flexion was 100 degrees, extension being limited by 10 degrees. Five years later, at the age of seventy-one, he has very little pain and can walk well for five miles with no limp; the knee is stable, there is no effusion, extension is full and the range of flexion is 110 degrees. Recent radiographs still show arthritic changes (Fig. 8) and the quadriceps muscle is still wasted one inch, but the patient is very well pleased with the result.

## RESULTS

The table opposite shows the results in thirty-two patients, twenty-four of whom have been studied three or more years after operation. Twenty-two of the thirty-five operations were performed in patients over the age of fifty, all with osteoarthritis of common types.

The operation was considered a success if the patient's pain was abolished or greatly relieved, if the knee retained or regained nearly full extension and movement through a right angle, and if the joint became stable enough for normal activity. These conditions were fulfilled after twenty-three of the thirty-five operations, in twenty-two patients.

The patients themselves used less stringent criteria of success, and were more easily pleased than an objective reviewer. Indeed, only three were dissatisfied, though two others suffered relapses after satisfactory results which had lasted four and seven years. One of these two patients (Case 1) has since been operated on again with a satisfactory result.

*Relief of pain*—In twenty-five patients (twenty-eight knees) pain was abolished or greatly reduced. The operation in fifteen of these patients (seventeen knees) included removal of the patella. In two patients the pain was unaltered, while in the remaining five the pain was considerably relieved. No patient was any worse for the operation.

*Knee movement*—Full extension was regained or recovered in twenty-five knees (twenty-three patients). In seven the knee recovered all but ten degrees of extension; and in three extension finally lacked twenty degrees or more.

Flexion to or beyond the right angle was obtained in twenty-seven knees (twenty-six patients). Two joints have remained very stiff, one case being the patient whose femur was fractured during manipulation. The remaining six have a useful range of flexion, though less than the right angle.

Quadriceps wasting has persisted in all cases, but twenty-seven patients consider their knees reasonably strong and stable; five report some instability.

In assessing these results it is fair to note that although about one operation in three was regarded as a failure, conservative treatment had failed to give improvement in all these

TABLE I—RESULTS IN THIRTY-TWO PATIENTS ONE YEAR OR MORE AFTER OPERATION

| *No.* | *Follow-up in years* | *Sex* | *Age* | *Patellectomy* | *Pain* | *Extension* | *Range of flexion* | *Strength and stability* | *Satisfactory to* | | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | *Reviewer* | *Patient* | |
| 1 | 8 | F | 30 | Yes | None | Full | 90° | Good | Yes | Yes | Good for 7 yrs. Second operation |
| 2 | 6 | F | 36 | Yes | None | Full | 90°+ | Good | Yes | Yes | Bilateral case |
| 2*a* | 5 | F | 37 | Yes | None | Full | 90°+ | Good | Yes | Yes | |
| 3 | 6 | M | 65 | Yes | Slight | Full | 90°+ | Good | Yes | Yes | |
| 4 | 5 | M | 60 | No | Diminished | −10° | A few degr. | Bad | No | No | Femur fractured during manipulation |
| 5 | 5 | M | 62 | No | Diminished | Full | 70° | Good | No | Yes | |
| 6 | 5 | M | 46 | Yes | None | Full | 90°+ | Good | Yes | Yes | |
| 7 | 5 | M | 45 | No | Slight | Full | 90° | Good | Yes | Yes | |
| 8 | 5 | F | 21 | No | None | Full | 90° | Good | Yes | Yes | |
| 9 | 5 | M | 45 | No | No change | −20° | 70° | Bad | No | No | Good for 4 yrs., then progressively worse |
| 10 | 5 | M | 40 | No | None | Full | 90° | Good | Yes | Yes | |
| 11 | 5 | M | 45 | No | Slight | Full | 90° | Good | Yes | Yes | |
| 12 | 5 | F | 49 | No | Diminished | −10° | 80°+ | Moderate | No | Yes | |
| 13 | 4 | F | 56 | No | Diminished | −10° | A few degr. | Bad | No | Yes | |
| 14 | 4 | M | 66 | Yes | Slight | Full | 90°+ | Good | Yes | Yes | |
| 15 | 4 | F | 62 | Yes | None | Full | A few degr. | Good | No | Yes | |
| 16 | 4 | M | 50 | Yes | Slight | Full | 90° | Good | Yes | Yes | |
| 17 | 4 | M | 39 | Yes | None | Full | 90°+ | Good | Yes | Yes | |
| 18 | 4 | M | 44 | No | Slight | Full | 50° | Moderate | No | Yes | |
| 19 | 3 | F | 52 | Yes | No change | Full | 50° | Bad | No | No | |
| 20 | 3 | M | 52 | No | Slight | Full | 90°+ | Bad | No | Yes | |
| 21 | 3 | F | 52 | Yes | Slight | Full | 90°+ | Good | Yes | Yes | |
| 22 | 3 | F | 65 | Yes | None | Full | 90° | Good | Yes | Yes | |
| 23 | 3 | F | 52 | Yes | Slight | −10° | 80°+ | Moderate | Yes | Yes | |
| 24 | 3 | F | 65 | Yes | Slight | −10° | 80°+ | Moderate | Yes | Yes | |
| 25 | 2 | F | 53 | No | Slight | −20° | 70°+ | Moderate | No | Yes | |
| 26 | 1 | F | 62 | Yes | Slight | −10° | 80° | Good | Yes | Yes | Bilateral case |
| 26*a* | 1 | F | 62 | Yes | Slight | −20° | 50° | Good | No | Yes | |
| 27 | 1 | M | 46 | No | Slight | Full | 90° | Good | Yes | Yes | |
| 28 | 1 | M | 65 | No | Slight | Full | 90° | Good | Yes | Yes | Bilateral case |
| 28*a* | 1 | M | 65 | No | Slight | Full | 50° | Good | No | Yes | |
| 29 | 1 | M | 58 | No | Slight | Full | 90° | Good | Yes | Yes | |
| 30 | 1 | F | 68 | Yes | None | Full | 90°+ | Good | Yes | Yes | |
| 31 | 1 | F | 62 | Yes | None | Full | 90°+ | Good | Yes | Yes | |
| 32 | 1 | F | 54 | Yes | None | Full | 90°+ | Good | Yes | Yes | |

patients. Moreover, the operation does nothing to jeopardise the success of arthrodesis, should it be needed later. The successful cases are surprisingly good, and the improvement certainly can be maintained for at least five years. Removal of the patella makes no significant difference to the results.

## SUMMARY

Joint débridement, by excision of synovial membrane, osteophytes, degenerate cartilage, loose bodies, and frequently the patella, has relieved the symptoms of osteoarthritis of the knee joint twenty-three times in a series of thirty-five operations reviewed after periods of one to nine years. The operation is considered a useful measure when symptoms resist conservative treatment.

The author's thanks are due to Mr K. H. Pridie for permission to use his clinical material, and to Mr F. Godman for the photographs.

## REFERENCES

COONSE, K., and ADAMS, J. D. (1943): A new operative approach to the knee joint. Surgery, Gynecology and Obstetrics, **77,** 344.

HAGGART, G. E. (1947): Surgical treatment of degenerative arthritis of the knee joint. New England Journal of Medicine, **236,** 971.

MAGNUSON, P. B. (1941): Joint débridement. Surgical treatment of degenerative arthritis. Surgery, Gynecology and Obstetrics, **73,** 1.

# PREGNANCY AND SKELETAL TUBERCULOSIS*

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When a maternity unit for tuberculous women was opened at Black Notley in 1937, there were some fears for the outcome, pregnancy being held in current medical opinion as harmful to tuberculous women. But the problem remained that many were in fact becoming pregnant, and provision for their confinement was made difficult by the reluctance of many nursing homes and hospitals to admit patients who might be infectious.

More than 300 women with tuberculosis have now had their confinements in the Black Notley unit. The results in those suffering from pulmonary tuberculosis were published in 1946 by Cohen, who found that when supervision and treatment were adequate there was no evidence that pregnancy, labour and the puerperium had any harmful effect on the course of the disease. In 1947 Stewart and Simmonds came to substantially the same conclusions after a searching investigation under the auspices of the Middlesex County Council.

The literature on pregnancy and skeletal tuberculosis is very scanty; the few references that I have been able to find will be quoted.

Myers (1891) reported a series of fourteen patients who had been cured of Pott's disease and among whom there were altogether twenty-four confinements with no ill effects. He also reported seven patients confined when there was active tuberculosis of the spine: six suffered adversely, but none of the seven patients was reported to have had any special treatment for their active spinal lesions.

Norris (1931) stated that tuberculosis of bone was little influenced by pregnancy; he had seen a number of patients, including some with lesions of the hip and spine, but in none was the disease aggravated. He also quoted Pinard (1912) who reported that he had never seen a case of bone tuberculosis aggravated by pregnancy.

Seddon and Strange (1940), writing on tuberculosis of the sacro-iliac joints, recorded an investigation of ten women with sacro-iliac tuberculosis who later became pregnant. They concluded that if the lesion appeared well-healed, there was little risk of reactivation of the disease.

The views of Stanger (1949) have recently been reported briefly. He collected eighteen cases that he considered relevant to an inquiry into the effects of pregnancy on skeletal tuberculosis. Though some of these patients had suffered reactivation, Stanger thought that little permanent harm had followed.

## CASE REPORTS

Full reports on the later histories of 132 women with various kinds of skeletal tuberculosis have been available. Of these, ten died, sixty-seven married either before or after the onset of disease, and fifty-five remained single. Thirty-two of the married women had forty-five children, an average of 1·4. Most of these women had been treated for their tuberculous infection at Black Notley. A few women are also included who were previously treated at other hospitals and were later admitted to the maternity unit for confinement, but the majority had their babies at home. Some details of these thirty-two patients will be given according to the situation of the skeletal lesion.

* This article is based on a paper read at a meeting of the British Orthopaedic Association in Bristol in October 1949.

**PATIENTS WITH SPINAL TUBERCULOSIS: 14 CASES**

**Case 1.** *J. D.*—had tuberculosis of the upper dorsal spine in childhood, and was discharged from Black Notley with the disease quiescent in 1934. She married in 1943 and had a normal confinement in 1944 without ill effect.

**Case 2.** *Q. N.*—was discharged from Black Notley at the age of fifteen years after treatment for tuberculosis of the fourth and fifth lumbar vertebrae. She married at seventeen years and has had five children. Her general condition is good and radiographs show a well-healed lesion. She writes: "Having children has been the making of me. . . . I have the quickest and easiest confinements any woman could have."

**Case 3.** *C. T.*—was discharged at the age of eleven years after treatment for tuberculosis of the fourth and fifth lumbar vertebrae. She was married at twenty years and has had two normal confinements. Her husband writes: "My wife wishes me to tell you that after eight years of married life with two children, one seven and the other nearly two, she enjoys the very best of health."

**Case 4.** *K. N.*—was discharged at the age of eighteen years after treatment for tuberculosis of the twelfth dorsal and first lumbar vertebrae. She married in 1944 at twenty years. A daughter was born in the unit a year later with no ill effect.

**Case 5.** *O. T.*—a middle-aged woman, was admitted with an extensive but well-calcified lesion of the spine, present since childhood. A paravertebral sinus of recent origin healed after a few months' constitutional treatment. Eight years previously she had had a normal confinement without ill effect.

**Case 6.** *F. N.*—was discharged in 1947 at the age of twenty-six years after treatment for tuberculosis of the twelfth dorsal and first lumbar vertebrae. Two years later she was admitted to the unit for confinement, which was uneventful. Radiographs of the spine at that time showed bony fusion.

**Case 7.** *S. D.*—had had an artificial abortion when tuberculosis of the spine was first diagnosed, before she was admitted for tuberculosis of the tenth and eleventh dorsal vertebrae. A year after her discharge in 1947 she returned to the unit for a normal confinement, from which there was no ill effect. At that time radiographs showed bony ankylosis of the affected vertebrae.

**Case 8.** *H. O.*—had been treated for tuberculosis of the fourth and fifth lumbar vertebrae in childhood. In 1945, at the age of twenty-nine years, she was admitted to Black Notley for a confinement. Caesarian section for pelvic contracture was performed and her progress was uneventful.

**Case 9.** *I. T.*—was treated for tuberculosis of the second and third lumbar vertebrae, and was discharged at the age of twenty-nine years. She had a successful confinement in 1939 and states that she is in perfect health.

**Case 10.** *D. D.*—aborted spontaneously shortly after admission to Black Notley in 1941 for treatment for tuberculosis of the eleventh and twelfth dorsal vertebrae. Her subsequent progress was slow and she developed paraplegia of late onset which was cured after a lateral decompression operation in 1946. She had an uneventful confinement in the maternity unit in 1949, and is in good health with no recurrence of the disease.

**Case 11.** *F. M.*—had two children before contracting pleurisy and pneumonia in 1938; a cold abscess of the chest wall developed. About this time an artificial abortion was performed at the sixth month. Nineteen months afterwards she was admitted to Black Notley for the treatment of multiple tuberculous lesions, and after several courses of treatment her disease improved. She became pregnant again in 1946 and had a further artificial abortion; at the same time sterilisation was performed. She died the following year.

**Case 12.** *W. E.*—had two children and was healthy until the onset of tuberculosis of the lower dorsal spine for which she was treated at Black Notley during 1942 and 1943. She returned for a confinement in the maternity unit in 1949. There was no ill effect.

**Case 13.** *L. E.*—was healthy until the onset of tuberculosis of the spine in 1942. She was treated in Black Notley for tuberculosis of the dorso-lumbar spine with sinuses from September 1947 to October 1948. In 1949 she had a confinement in a hospital near her home; follow-up examination in 1950 shows well-healed disease.

**Case 14.** *B. C.*—was aged twenty-six years when she was admitted to Black Notley in 1945 suffering from tuberculosis of the twelfth dorsal and first lumbar vertebrae. She was discharged in 1946, but subsequently developed a pulmonary tuberculous lesion for which futher treatment was required. In 1949 she had a normal confinement. The disease in her spine and in her lungs was at that time quiescent and she has remained well since.

A few comments are necessary on the patients with spinal tuberculosis and pregnancy. No reactivation of disease, increase of deformity or difficulty in labour occurred as a result

of parturition. The patient *H. O.* (Case 8) had a Caesarian section, not because of the tuberculous disease, but because of pelvic contraction. Some perplexity was felt about the patient *D. D.* (Case 10), admitted with active tuberculosis of the spine and pregnancy, until she aborted spontaneously. Experience would now lead me to reassure such a patient, to treat the spinal tuberculosis, and to obtain as much quiescence of the spine as possible, before delivery either normally or by Caesarian section. The patients *S. D.* (Case 7) and *F. M.* (Case 11) had artificial abortions. The spinal disease appeared to be unaffected in the patient *S. D.*, but the patient *F. M.* developed multiple tuberculous lesions in the ankle and spine and ultimately died.

FIG. 1

Case 16 (*J. O.*)—The radiograph shows the descending foetal head and the manner in which it could squeeze out a residual intrapelvic abscess into the thigh. This would not necessarily be evidence of fresh disease (see Case 19).

FIG. 2

Case 17 (*M. K.*)—This patient had old tuberculosis of both hips with fibrous ankylosis and only a few degrees of movement. Adduction deformity of the right hip was corrected by a low osteotomy. She has since had one normal confinement.

**PATIENTS WITH TUBERCULOSIS OF THE HIP: 5 CASES**

**Case 15.** *L. H.*—was treated for tuberculosis of the hip at Black Notley and was discharged at the age of fourteen years. Subsequently a strong fibrous ankylosis developed. She married, and had a child in 1946; the labour was normal and there was no ill effect.

**Case 16.** *J. O.*—had tuberculosis of the left hip in childhood. She married and had one child. Two years after her first confinement she was admitted for the correction of a flexion and adduction deformity. She had another child in 1949. Both deliveries were by Caesarian section. There was no evidence of reactivation after either confinement (Fig. 1).

**Case 17.** *M. K.*—had bilateral disease in childhood. At the age of eighteen only a few degrees of movement were present in each hip, and an adduction deformity of the right hip was corrected by osteotomy. She later married and in 1947 had a normal labour with no ill effect (Fig. 2).

**Case 18.** *W. G.*—was treated in childhood for tuberculosis of the hip, ending with ankylosis. She married in 1946 and had a confinement in 1947. She writes that she had thirty stairs to climb from kitchen to sitting-room all through her pregnancy, but had a normal confinement, a healthy child and no ill effects.

**Case 19.** *F. T.*—was treated for tuberculosis of the left hip during childhood. She married and had a confinement in 1948, during which she developed a cold abscess in the thigh. Unsound ankylosis was present with flexion and adduction deformity.

It can be deduced that a patient with a fixed hip, or even two fixed hips, may have a normal labour. The patient *J. O.* (Case 16), who had two Caesarian sections, was thought to have a contracted pelvis, and these operations were done for obstetric reasons. The patient *M. K.* (Case 17) with bilateral ankylosis of the hips (Fig. 2) had a normal confinement. In a personal communication, Mr Alan Brews has told me that abduction of the hips is not required for a normal delivery, as the child is delivered forwards.

The patient *F. T.* (Case 19), who developed an abscess of the thigh during pregnancy, had long-standing fibro-caseous disease of the hip with unsound ankylosis in flexion and adduction. The character of the pus when aspirated suggested old sero-caseous material which may have been expressed from the pelvis by the foetal head. She was admitted to Black Notley following a normal confinement, and after four months' constitutional treatment an osteotomy and graft were performed. Figure 1 (a radiograph of another patient) shows how the foetal head may express a residual intrapelvic abscess into the thigh.

#### PATIENTS WITH TUBERCULOSIS OF THE KNEE: 7 CASES

**Case 20.** *K. D.*—was treated in childhood at Black Notley for tuberculosis of the left knee and ankle. Bony fusion developed in both these joints. She had good function and earned her living on the stage. She married in 1945, and a child was born in 1947 with no ill effects.

**Case 21.** *J. F.*—was treated at Black Notley at the age of twenty-six for tuberculosis of the knee and of the lungs, the sputum being positive. Excision of the knee was performed and she was discharged in 1939. She had one child in 1943 and another in 1947, and has kept well.

**Case 22.** *O. F.*—was treated at the age of twenty-four years for tuberculosis of the knee and of the lungs, the sputum being positive. Excision of the knee was performed after constitutional treatment and she was discharged in 1938. She married in 1945, had a child in 1947 and is keeping well.

**Case 23.** *Q. X.*—was treated at the age of nineteen years at Black Notley for tuberculosis of the knee, excision being performed. She was discharged in 1937 and married in 1946. A baby was born in 1947 and she is keeping well.

**Case 24.** *F. S.*—was treated conservatively in childhood at Black Notley for tuberculosis of the knee. Later she married and had two children. After the second confinement she felt some strain on her knee but the symptoms did not persist. She was readmitted to Black Notley two years afterwards with a painful fibrous ankylosis for which excision was performed. She has later had two more children. She writes: "I have four children altogether, the eldest being six years old. I do all my own housework, laundry, shopping etc., but my legs never tire or ache. I am now in the best of health and very happy indeed."

**Case 25.** *H. Q.*—was admitted to Black Notley in 1944 at the age of twenty-seven years with active tuberculosis of the right knee; she was then eight months pregnant. Her knee was put in a plaster splint well cut away on the inner side of the thigh, and she was confined normally. Two months after confinement excision of the knee was performed. She was discharged with the disease quiescent and was well when last seen.

**Case 26.** *F. S.*—was treated at the age of twenty-two years at Black Notley for tuberculosis of the knee and pulmonary tuberculosis. The sputum was positive. Excision of the knee was performed after constitutional treatment, and she was discharged with the disease quiescent. She married, and in 1945 had a baby in the unit without ill effect. She was seen a year later when there was sound healing of the disease in the lungs and the knee. Her general health was then excellent. In 1949 she died after a rapid illness, the nature of which has not been determined.

A feature of this group of patients with pregnancy and tuberculosis of the knee is the frequent association of pulmonary tuberculosis with tuberculosis of the knee in young women. The combined lesion yields to treatment, especially after excision of the knee, and no ill effect attributable to pregnancy has been observed.

#### PATIENTS WITH TUBERCULOSIS OF THE SACRO-ILIAC JOINT: 2 CASES

**Case 27.** *I. H.*—was treated at the age of twenty-four years at Black Notley for disease of the left sacro-iliac joint. She was discharged in 1938, married in 1940 and has had two babies since, both delivered by Caesarian section. There has been no ill effect.

**Case 28.** *W. M.*—was treated at the age of eighteen years at Black Notley for tuberculosis of the right sacro-iliac joint. Large subgluteal abscesses were present and many pints of pus were aspirated. She was discharged in 1946 and married the same year. She was admitted to the maternity unit in 1948, being then six months pregnant. There was a small tuberculous abscess in the thigh which had appeared recently; for this reason a Caesarian section was performed, but the baby died of pulmonary atelectasis. The patient again became pregnant and the abscess in the thigh reappeared. In 1949 she had a normal confinement in a hospital near her home and is well. The abscess in her thigh was probably due to the expression of a residual abscess from the pelvis by the foetal head. A radiograph taken after the second pregnancy in 1949 showed healing more sound than on discharge after treatment in 1946.

No comment is required on these two patients who had pregnancy and sacro-iliac tuberculosis.

#### PATIENTS WITH TUBERCULOSIS OF THE SHOULDER, FOOT OR WRIST: 4 CASES

**Case 29.** *F. T.*—had been treated for tuberculosis of the astragalus involving also the ankle and subastragaloid joints. The foot had healed well after constitutional and operative treatment. She had one confinement in 1948 without ill effect.

**Case 30.** *Q. F.*—was treated at the age of twenty-two years at Black Notley for tuberculosis of the tarsus and pulmonary tuberculosis. After constitutional treatment the tarsal lesion was curetted and grafted. Firm healing occurred. She was discharged in January 1946 and readmitted in October 1946 for confinement. There was no ill effect. The foot and the lung have remained well healed.

**Case 31.** *O. T.*—was treated in 1942 for tuberculosis of the first left metatarso-phalangeal joint; there was also bilateral apical pulmonary tuberculosis. Sequestrectomy of the joint was performed and subsequently both the joint and the lung disease healed. She had a confinement in 1948 and remains well.

**Case 32.** *N. T.*—was treated conservatively for tuberculosis of the right wrist at twenty-six years. Since then she has had three children. She writes that despite a stiff wrist she manages her housework quite well and is in good health.

No comment is required on these patients.

## CONCLUSIONS

The case histories of these Black Notley patients show that no serious harmful effects have been caused by pregnancies going to full term. Most of the patients had normal confinements; Caesarian sections were few and were usually done for obstetric reasons, not for fear of reactivation of the disease. This experience bears out a remark made to me by Marcel Galland. When asked if Caesarian sections were required for women who became pregnant after treatment at Berck for skeletal tuberculosis, he replied: "*Jamais! Tout passe!*"

Two patients in the series had artificial abortions, and one aborted spontaneously. Two of these three patients did not do as well as other patients whose pregnancies went to full term.

Quite another question is whether the onset of skeletal tuberculosis soon after pregnancy may be attributed to the pregnancy. In a group of women of child-bearing age, it would be difficult to distinguish between *post hoc* and *propter hoc* in considering this question. One patient of this series, *H. Q.* (Case 25), was admitted eight months pregnant with active tuberculosis of the knee; but pain in the joint had started fifteen months before admission, and the onset of disease no doubt preceded the pregnancy. Some of the patients admitted to Black Notley were mothers of young children but there is no note of any pregnancy having preceded the onset of tuberculosis by a short interval. The follow-up reports of the married patients compare favourably with those of the unmarried.

Further, it may be argued that pregnancy increases resistance to tuberculosis. Such a belief was current from the time of Hippocrates until the middle of the nineteenth century, and clinical evidence can be quoted in favour of such a view. In America, Lyman (1943) followed up 1,818 women who had been treated for tuberculosis in a sanatorium; many had married despite medical advice to the contrary. Lyman found that the late results of treatment were four times as good in the married patients as in the single women. Lyman says, "When

we consider that the married group established this record in spite of the fact that 192 out of 315 gave histories of pregnancies (averaging 2·25 children each), it is clear that some factor not yet accounted for has exerted a profound influence in their cases."

I have speculated elsewhere as to what this factor may be (Wilkinson 1949). But it seems clear that increased sterol circulation in the body is associated with increased reticulo-endothelial activity (Fraser 1935). Thus reticulo-endothelial proliferation has been observed in the lesions of lupus following the administration of calciferol (Dowling, Gauvain and Macrae 1948). An increase of blood cholesterol is found during pregnancy. The sex hormones are sterols and might be expected to be raised in the marital state; it is perhaps significant that marital contacts form a group relatively immune to tuberculosis.

There would appear to be good grounds for reassuring the married woman who has suffered from skeletal tuberculosis regarding the prospect of normal pregnancy. Many letters received from patients in a follow-up of this sort are poignant documents. There is no doubt that the majority of these women desire children as ardently as normal women, and that a safe confinement following skeletal tuberculosis is an excellent form of rehabilitation.

## REFERENCES


Brews, R. A.: Personal communication.

Cohen, R. C. (1946): Pulmonary Tuberculosis and Pregnancy. British Journal of Tuberculosis, **40,** 10.

Dowling, C. B., Gauvain, S., and Macrae, D. E. (1948): Vitamin D in Treatment of Cutaneous Tuberculosis. British Medical Journal, **1,** 430.

Fraser, J. (1935): Skeletal Lipoid Granulomatosis. British Journal of Surgery, **22,** 800.

Galland, Marcel: Personal communication.

Lyman, D. R. (1943): Pregnancy and Tuberculosis. Yale Journal of Biology and Medicine, **15,** 465.

Myers, T. H. (1891): Pott's Disease and Pregnancy. Transactions of the American Orthopedic Association, **4,** 124.

Norris, C. C. (1931): Gynecological and Obstetrical Tuberculosis. (Gynecological and Obstetrical Monographs, 11.) New York and London: D. Appleton and Company, p. 219.

Pinard, A. (1912): De l'avortement soi-disant thérapeutique chez les femmes tuberculeuses en état de gestation. Annales de Gynécologie et d'Obstétrique, 2e serie **9,** 321.

Seddon, H. J., and Strange, F. G. St C. (1940): Sacro-iliac Tuberculosis. British Journal of Surgery, **28,** 213.

Stanger, K. (1949): Report of meeting of the Newcastle-upon-Tyne Obstetrical and Gynaecological Society and the North of England Tuberculosis Society. British Medical Journal, **1,** 1048.

Stewart, C. J., and Simmonds, F. A. H. (1947): Child Bearing and Pulmonary Tuberculosis. British Medical Journal, **2,** 726.

Wilkinson, M. C. (1949): Observations on the pathogenesis and treatment of skeletal tuberculosis. Annals of the Royal College of Surgeons of England, **4,** 168.


## DISCUSSION BY F. G. ST CLAIR STRANGE

*(Contributed after the original reading of the Paper)*

Mr F. G. St Clair Strange said that he was in agreement with Mr Wilkinson's views, and would like to reinforce one of the groups of case reports with some from his own experience.

The sacro-iliac was the joint which, above all others, one would expect to become reactivated in pregnancy and labour, owing to the great vascular changes and mechanical stresses which affect it. In his series of ninety-nine cases there were fifty-six women. In four cases pregnancy had precipitated the onset, or at least had immediately preceded it. Fifteen women had died under treatment or within three years of discharge, and four had not been traced. In two others, the follow-up was incomplete. Of the remaining thirty-five, fifteen were single, three were over child-bearing age and a further two had had gynaecological operations which

prevented pregnancy. This series therefore concerned fifteen married women with quiescent sacro-iliac tuberculosis.

Of the fifteen women who were married, of child-bearing age and able to have children, twelve had had twenty-seven pregnancies, and one was pregnant for the sixth time. There were no Caesarian sections and no case of recurrence of activity in the sacro-iliac joint. There was one miscarriage, one stillbirth at eight months from antepartum haemorrhage and one death, from broncho-pneumonia of uncertain etiology three months after a second pregnancy. In one case only was pregnancy followed by the development of tuberculosis in a remote joint.

One of his patients had written in 1939 saying that she did not think it wise for her to have any pregnancies, and the speaker had felt remiss in having failed to advise her otherwise. But later, in 1946, she developed a tuberculous wrist. If she had been told that pregnancy carried little risk, she might have waited till the war was over before starting a family: the coincidental development of a tuberculous wrist would then have been blamed on the pregnancy.

To summarise, one might say that pregnancy appeared to carry no material risk of reactivation of a tuberculous sacro-iliac joint that was clinically and radiographically quiescent, and no interference with normal labour need be expected.

# FRACTURES OF THE HEAD OF THE RADIUS IN CHILDREN

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*From the Birmingham Accident Hospital*

Fractures of the head of the radius with displacement are relatively uncommon in children. During six years, 450 cases of fracture of the radial head have been treated at the Birmingham Accident Hospital. Of these eighty were in patients under the age of eighteen years; but when cases of fissure fracture and greenstick fracture with minimal deformity were excluded (together with one or two cases occurring in the older children with slight depression of a quadrant of the radial head) there remained only twenty-four cases for consideration. The twenty-four cases fell into two groups, one large and one small, with quite distinct deformities and mechanism: in Group 1 (twenty-two cases) there was lateral tilting of the head by 30 degrees or more, caused by fracture-separation of the epiphysis or greenstick fracture of the neck with angulation; in Group 2 (two cases) there was backward rotation of the head through 90 degrees.

**Group 1.** *Mechanism.*—The theory of causation follows mainly the accepted view. A fall on the outstretched hand drives the capitellum against the outer side of the head of the radius, tilting and displacing it outwards (Fig. 1). Such a mechanism implies a valgus strain on the elbow at the moment of injury, and one can therefore expect to find an associated traction lesion on the inner side of the joint. This may take the form of avulsion of the medial epicondyle (Dunlop 1935), or rupture of the medial collateral ligament. Further, in four cases in this series with an associated fracture of the olecranon or upper shaft of the ulna, the patterns of the ulnar fractures indicated causation by an abduction force (Fig. 2). Direct injury can seldom cause a fracture of the head of the radius, and never of this type (Murray 1940).

No serious effort has previously been made to ascertain the direction of tilting of the radial head, but it was usually accepted as being outwards (Fitzgerald 1946). This is in fact a true picture, but, because the head of the radius has a normal rotational range of approximately 160 degrees, a more accurate interpretation is necessary (Fig. 3). The direction of tilting of the displaced head *relative to the shaft of the radius* varies with the rotational

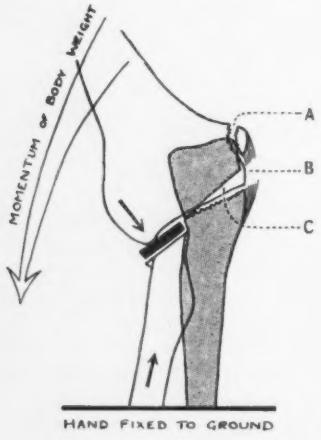


FIG. 1

Diagram to show the mechanism of fracture of the head of the radius. The compression force on the radial side and the associated traction lesions on the ulnar aspect are indicated: *A*—avulsion of the medial epicondylar apophysis, *B*—rupture of the medial collateral ligament, or *C*—fracture of the olecranon or upper ulna of abduction type.

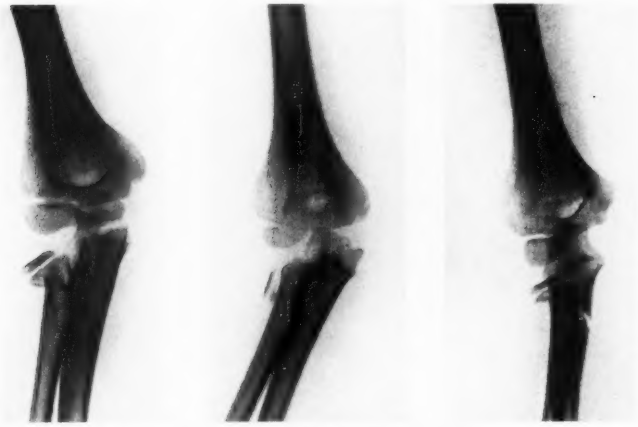

FIG. 2

Radiographs of three patients to show associated fractures of the olecranon or ulnar shaft, each of a type consistent with its having been caused by an abduction force.

FIG. 3

Antero-posterior radiographs of the forearm to show the differing appearances of the radius in pronation, mid rotation and supination. Attention is drawn to the variation in the appearance and position of the bicipital tuberosity, and in the relationship of the radius to the ulna.

FIG. 4

FIG. 5

Radiographs showing a supinated radius (Fig. 4) and a radius in mid-rotation (Fig. 5), the head laterally displaced and depressed in each case.

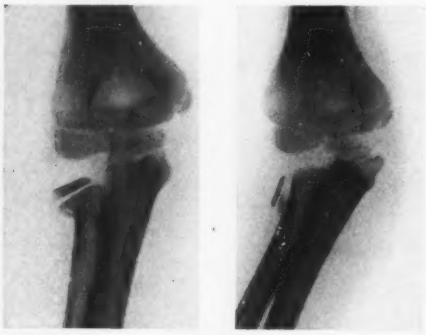

FIG. 6

Radiographs showing moderate and complete degree of displacement of the head of the radius (Group 1).

position of the radius at the time of injury. Thus, if the forearm is supinated at the moment of impact, the displacement of the capital epiphysis is outward, with outward tilting, and this displacement is shown in the usual antero-posterior radiograph taken in supination (Fig. 4). But if the forearm is in mid-position the adjacent posterior quadrant of the radial head is subjected to the greatest violence (Fig. 5), and when the forearm is returned to a position of full supination the head is tilted backwards in relation to the radial shaft.

The least deformity qualifying for this group was tilting of the head of the radius by 30 degrees from the horizontal. There were four cases in which the deformity was maximal and in which the head lay parallel with the outer side of the shaft of the radius (Fig. 6).

*Associated injuries*—Three patients had avulsion fractures of the whole or part of the medial epicondyle, three had fractures of the olecranon and one a fracture of the upper part of the shaft of the ulna; one patient had a forward dislocation of the upper radial shaft.

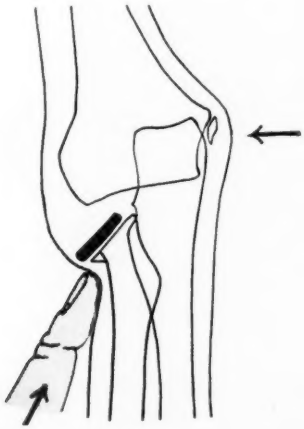

FIG. 7
Diagram illustrating manipulative reduction.

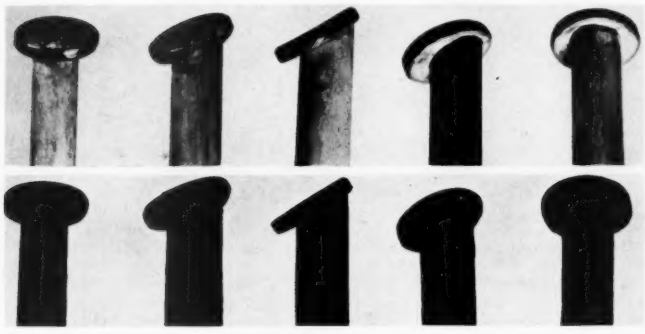

FIG. 8
A model photographed in various positions of rotation and the corresponding shadows below. The central shadow shows the narrow rectangle referred to in the text. It is in the rotational position casting this shadow that the forearm should be placed during manipulation so that digital pressure can be applied effectively from the lateral aspect.

*Treatment*—Manipulative reduction is attempted, unless the capital epiphysis is completely displaced. Under general anaesthesia the elbow is extended and the forearm is adducted to open the outer side of the joint. The forearm is then rotated so that the most prominent part of the displaced head is disposed laterally, where it is superficially placed between the extensor group of muscles and the anconeus. Strong digital pressure is made upwards and inwards upon this part of the head (Fig. 7).

It is important to know when the most prominent part of the radial head is situated laterally, especially if swelling prevents palpation. This information may be obtained from the study of antero-posterior radiographs centred upon the head of the radius and taken in various known positions of rotation. If the line of the central ray and the position of the humerus and ulna remain constant, the disc-shaped head of the radius throws shadows that differ in shape with its rotational position (Fig. 8). When the most depressed portion lies

laterally, the shadow is a narrow rectangle. This rotational position is the one in which the forearm should be placed during manipulation so that the digital pressure can be effectively applied from the lateral aspect (Fig. 9). Successful reduction is followed by three to four weeks' immobilisation in a full-length arm plaster, with the elbow at a right angle and the forearm in mid-rotation. Mobilisation is begun on removal of the plaster if union is adequate. When manipulative reduction has not been complete in very young children, spontaneous correction of deformity may be expected provided the angulation does not exceed 20 degrees.

Open reduction is undertaken only when the radial epiphysis is displaced completely from the shaft, or when manipulative reduction has been unsuccessful; it is usually done within three days of the injury. The radio-humeral joint is exposed and the radial head is replaced under pressure exerted to align it with the shaft. Leverage may be required to correct angulation in cases where manipulation has failed. The post-operative treatment is similar to that following manipulative reduction.

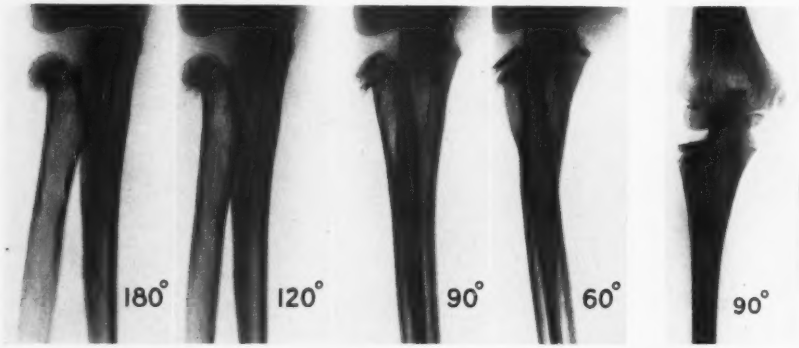


FIG. 9

Antero-posterior radiographs of a typical case taken in varying positions of rotation. The 180-degree view represents full supination and the 90-degree view mid-position. The 60-degree view—30 degrees to the pronation side of mid-position—was selected for the manipulation in this case. The right-hand radiograph is one of the same case four months after successful manipulative reduction.

**Group 2.** The second group comprised only two cases, in which the capital epiphysis was rotated backwards through 90 degrees (Fig. 10). Very few similar examples have been reported (Schwartz and Young 1933).

*Mechanism*—It is probable that the patient falls first on the hand, sustaining a temporary backward dislocation or subluxation of the elbow joint, which in turn strikes the ground. The resulting upward violence on the flexed elbow separates the capital epiphysis of the radius by impact against the inferior aspect of the capitellum. Spontaneous reduction of the dislocation leaves the separated head beneath the capitellum (Fig. 11). The preliminary fall on the hand was betrayed in one patient by an associated fracture of the scaphoid bone.

*Treatment*—The epiphysis is reduced by open operation because it is unlikely that manipulative reduction could be successful.

## RESULTS

The patients were reviewed between one and six years after injury, when all were free from symptoms and had no apparent deformity. (A tabular summary of the twenty-four cases is given at the conclusion of this paper.)

**Group 1**—The results in the twenty-two cases were analysed according to the original degree of tilting of the radial head.

FIG. 10

Radiograph showing the capital epiphysis of the radius rotated backwards by 90 degrees (Group 2).

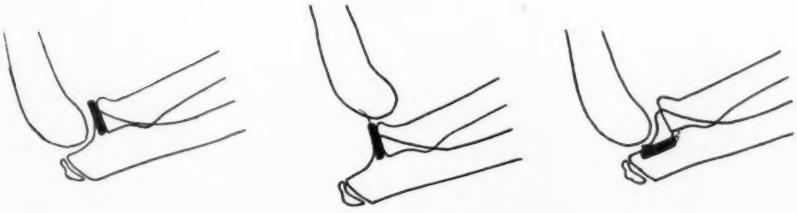

FIG. 11

Diagrams illustrating mechanism of displacement in cases of Group 2 type.

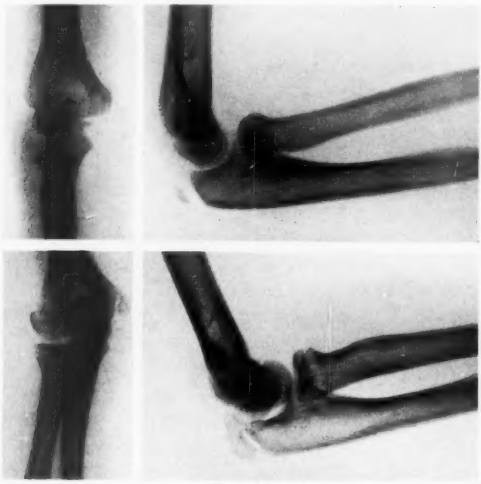

FIG. 12

A typical Group 1 case with 35-degree tilting of the radial head from the horizontal in a patient aged ten years, and the same case five years after successful manipulative reduction. Fusion of the epiphysis has begun earlier than on the opposite side.

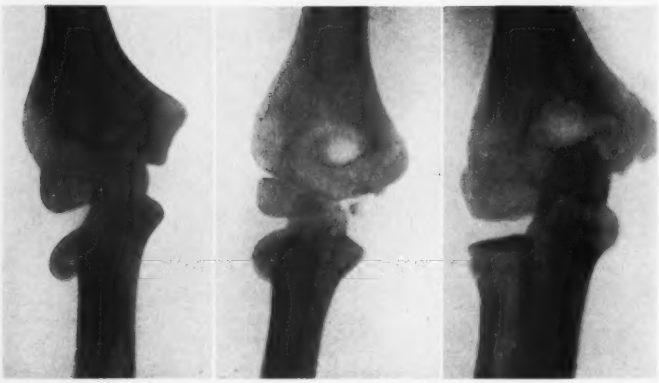

FIG. 13

Another typical case with 50-degree tilting of the radial head in a patient aged seven years. Incomplete reduction was accepted, but eighteen months later correction of deformity had occurred.

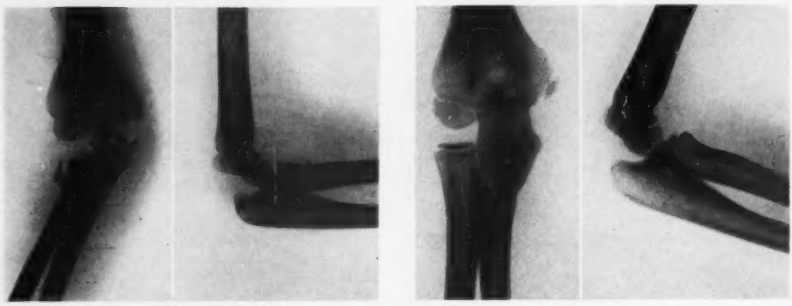

FIG. 14

A Group 1 case of complete displacement of the capital epiphysis with fracture of the olecranon in a patient aged eight years, and the appearances one year after open reduction.

*Downward tilting from* 30 *to* 60 *degrees: fourteen cases*—When reduction was satisfactory the results were equally good whether treatment was by manipulation or by operation. Thirteen out of fourteen patients had full elbow and forearm movement; only one had 10 degrees' limitation of rotation. The radiographic appearances were normal except that premature fusion of the capital epiphysis had begun in some cases (Fig. 12); four of these patients had been treated by open reduction. Although in four others complete reduction was not obtained, full function was present at review. One patient, aged seven years at the time of injury, had overcome the residual deformity by natural growth processes when seen eighteen months later (Fig. 13).

*Complete displacement of the head of the radius: four cases*—Three cases were treated by open reduction and one by excision of the head of the radius. In all there was restriction of rotation of the forearm varying from 20 to 60 degrees. Elbow movement was restricted by 20 degrees in three cases. Examples of the radiographic appearances found at review are shown, none being normal (Figs. 14 and 15).

**Group 2**—*Backward rotation of the head of the radius through* 90 *degrees: two cases*—Both

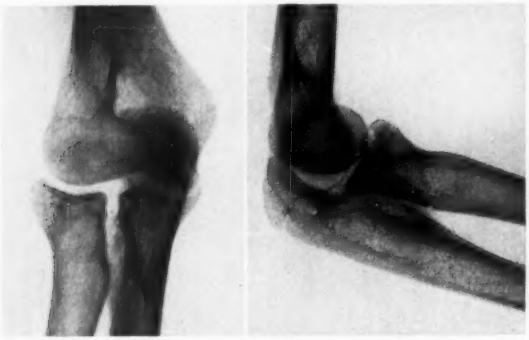

FIG. 15

A Group 1 case originally similar to the case shown in Figure 14, three years after open reduction. The patient was aged nine years at the time of injury. Note the early fusion and distortion of the radial head.

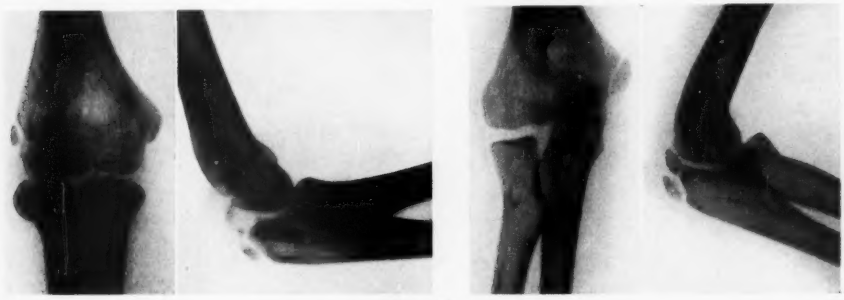

FIG. 16

A typical Group 2 case showing 90-degree backward rotation of the radial capital epiphysis in a patient aged thirteen years, and the appearances eighteen months after open reduction. Note the early fusion of capital epiphysis, although the shape of the radial head is normal.

cases were treated by open reduction. At review the patients had full elbow movement, but rotation of the forearm was restricted by 35 degrees in one and 50 degrees in the other. The radiographic appearances of one are shown in Figure 16.

## CONCLUSIONS

1. Full recovery after fracture of the head of the radius in children may be expected in cases with tilting of the radial head from 30 to 60 degrees, whether treated by early manipulative or by operative reduction.
2. Manipulative reduction is facilitated by knowledge of the direction of displacement and tilting of the radial head, which can be determined by the study of appropriate radiographs.
3. When the upper radial epiphysis is completely displaced from the shaft, some permanent loss of movement is to be anticipated even when accurate reduction has been secured by operation. Early fusion and some deformity of the radial head are also to be expected. This is not surprising in view of the risk to the blood supply of the displaced head, particularly in those cases treated by operative reduction.

TABLE I—A Summary of the Twenty-four Cases under Review

| Case | Age, sex | Associated lesions | Details of fracture | Manipulative reduction | Operative reduction | Period of immobilisation in weeks | Period before review in years | Range of flexion and extension | Range of pronation and supination | End-results | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Radiological features at time of review | Comments |
| **Group 1, Section A** | | | | | | | | | | | |
| 1, D. W. | 13, M | — | 30° tilting | Good | — | 2 | ½ | Full | Full | No abnormality | *Rupture of medial collateral ligament demonstrated radiologically* |
| 2, A. W. | 9, F | — | 30° tilting | Good | — | 3 | ½ | Full | Full | No abnormality | *Rupture of medial collateral ligament demonstrated radiologically* |
| 3, P. S. | 12, F. | — | 30° tilting | Failed | Good | 4 | ½ | Full | Full | No abnormality | — |
| 4, W. G. | 14, M | — | 40° tilting | Good | — | 5 | ½ | Full | Full | No abnormality | — |
| 5, B. W. | 7, F | — | Marked deformity, but assessment of tilting impossible from films available | Failed | — | 3 Sling only | 1 | Full | Full | Correction of deformity by natural growth processes not yet complete | *Deformity left when manipulation failed* |
| 6, B. P. | 12, M | — | 30° tilting | Failed | — | 2 | 1 | Full | Full | Correction of deformity by natural growth processes not yet complete | *Deformity left when manipulation failed. New bone formation below medial epicondyle in later films indicates rupture of medial collateral ligament* |
| 7, R. H. | 15, M | Avulsion of medial epicondylar epiphysis | Marked deformity, but assessment of tilting impossible from films available | Good | — | 4 | 1¼ | Full | Full | Radial head fusing slightly in advance of other side. Medial epicondyle remains slightly displaced | — |
| 8, B. S. | 7, F | — | 50° tilting | Fair | — | Sling only | 1½ | Full | Full | Little abnormality. Possible early signs of epiphysial fusion | *Considerable deformity was left after partly successful reduction* |
| 9, B. T. | 12, M | Fracture of medial epicondyle | 40° tilting | Good | — | 4 Sling only | 1¾ | Full | Full | No abnormality except commencement of union of epiphysis | — |
| 10, A. T. | 9, F | — | 30° tilting | Good | — | 3 | 2½ | Full | Full | No abnormality | — |
| 11, J. E. | 4, F | — | 60° tilting | — | Good | 3 | 3½ | Full | Full | No epiphysial fusion, but epiphysis and upper shaft of radius rather larger on fractured side | *Small bone peg used at operation to stabilise head of radius* |
| 12, D. G. | 11, M | Fracture of olecranon | Marked deformity, but assessment of tilting impossible from films available | Good | — | 5 | 4¼ | Full | Full | No abnormality | — |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13, P. J. | 7, F | — | 30° tilting | Good | — | 3 | 4½ | Full | Full | No abnormality | — |
| 14, J. A. | 10, M | — | 35° tilting | Good | — | 3 | 4½ | Full | Full | No abnormality | — |
| 15, B. T. | 9, M | Fracture of olecranon | 40° tilting | Failed | Good | 3 | 4¾ | Full | Both limited 10° | No abnormality | — |
| 16, O. M. | 12, F | — | 60° tilting | Failed | Fair | 3 | 5 | Full | Full | Both capital epiphyses fused; slight tilting still present | *The deformity left after operation has not been fully corrected by growth* |
| 17, H. H. | 5, F | Fracture of upper ulnar shaft | 40° tilting | Good | — | 6 | 6 | Full | Full | Radial head is commencing to fuse | — |
| 18, M. M. | 10, M | Avulsion of flake from medial epicondyle | Marked deformity, but assessment of tilting impossible from films available | Failed | Good | 4 | 6 | Full | Full | Radial head fusing slightly in advance of other side; medial epicondyle slightly deformed | — |
| **Group 1, Section B** | | | | | | | | | | | |
| 19, P. G. | 8, F | Fracture of olecranon | Head of radius parallel to outer side of shaft | Failed | Good | 6 | 1 | Full | 65/115° (90/150°) | Possibly early signs of epiphysial fusion | — |
| 20, D. F. | 9, F | — | Head tilted 50° and displaced by manipulation to lie parallel to outer side of shaft | Failed | Fair | 5 Sling only | 1½ | 40/180° (35/190°) | 70/125° (80/135°) | Epiphysis fused; some abnormal bone formation around radius neck | *Excellent remoulding of upper radial shaft with correction of incomplete reduction* |
| 21, N. D. | 12, M | Superior radio-ulnar dislocation | Head of radius parallel to outer side of shaft | — | — | 2 | 1¾ | 55/180° (40/180°) | 40/110° 65/(115°) | Upper end of radius remains subluxated forwards. Some small rounded bonefragments above neck of radius | *The epiphysis was excised* |
| 22, P. B. | 9, F | — | Head of radius parallel to outer side of shaft | — | Good | 4 | 3¼ | 35/165° (35/185°) | 60/100° (80/120°) | Epiphysis fused and head of radius very abnormal in shape. No abnormality at wrists | — |
| **Group 2** | | | | | | | | | | | |
| 23, S. A. | 13, M | Fracture of scaphoid | Head of radius rotated back by 90°; no downward displacement | — | Good | 13 | 1½ | Full | 55/90° (20/90°) | Fusion of head of radius, but radial head normal in shape | — |
| 24, T. R. | 10, M | — | Head of radius rotated backwards by 90°; no downward displacement | Failed | Good | 5 | 4¾ | Full | 65/60° (75/110°) | Epiphysis partly fused; head very abnormal in shape | — |

**Note**—Where the range of movement of the elbow or of the forearm is given in degrees, the range of the uninjured side is shown in brackets; In the case of pronation and supination, mid-position has been taken as 0°. In the case of flexion and extension, the position of normal extension has been taken as 180°.

I am indebted to Mr Mervyn Evans, whose earlier work on the importance of rotation in forearm injuries has been fundamental to this study, and to Mr F. G. Badger for his help with this paper. I would also express my thanks to Mr N. R. Gill of the Photographic Department of the Birmingham Accident Hospital and to my colleagues for permission to use their case records.

## REFERENCES

DUNLOP, J. (1935): Traumatic separation of the medial epicondyle of the humerus in adolescence. Journal of Bone and Joint Surgery, **17,** 584.

FITZGERALD, F. P. (1946): quoted by Bailey and Love in "A Short Practice of Surgery." Seventh edition. London: H. K. Lewis & Co. Ltd., 832.

MURRAY, R. C. (1940): Fractures of the head and neck of the radius. British Journal of Surgery, **28,** 109.

SCHWARTZ, R. P., and YOUNG, F. (1933): Treatment of fractures of the head and neck of the radius and slipped radial epiphysis in children. Surgery, Gynecology and Obstetrics, **57,** 528.

# SPONDYLOLISTHESIS WITH AN INTACT NEURAL ARCH—THE SO-CALLED PSEUDO-SPONDYLOLISTHESIS*

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In spondylolisthesis the usual cause of anterior displacement of a vertebra is a bilateral defect in the pars interarticularis. Sometimes there is no such defect and the whole vertebra including the spine and neural arch is displaced forwards (Fig. 1). Lambl (1858), Neugebauer (1889) and Chiari (1892), all of whom are quoted by Friberg (1939), were among the earliest investigators to study spondylolisthesis and were aware that spontaneous displacement of a vertebra could occur with an intact neural arch. After the common defect had been adequately described, however, little attention was paid to the possibility that subluxation of the posterior joints could allow forward displacement of the whole vertebra. In 1930 Junghanns once again pointed out that such displacement could occur and named the condition " pseudo-spondylolisthesis." He described beautifully the pathological changes in eleven cases found in the course of examining several hundred spines in Schmorl's collection. The term " pseudo-spondylolisthesis " is not a satisfactory one, however, because vertebral sliding is correctly called " spondylolisthesis " whether it is associated with a neural arch defect or not.

In clinical descriptions of spondylolisthesis those cases without neural arch defects had not been distinguished until 1941, when Hallgrimmson described the clinical and operative findings in a single case. This paper is mainly a report on the clinical findings in twenty-two patients.

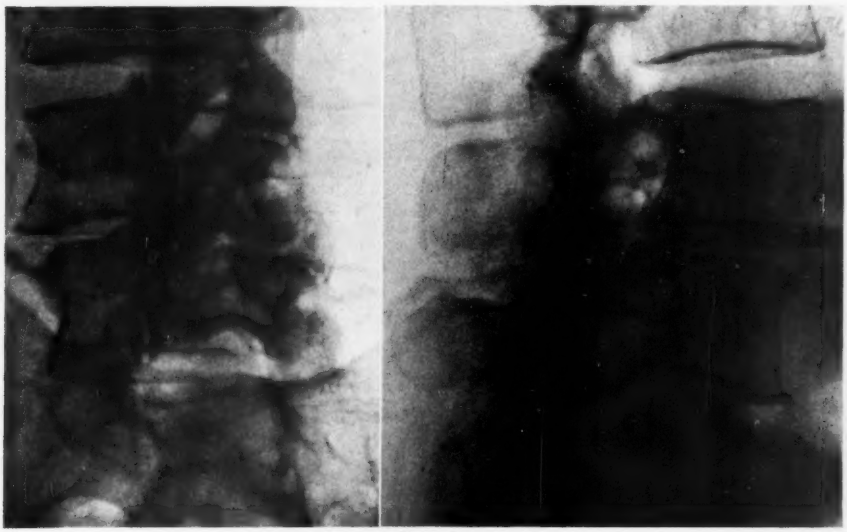

FIG. 1

Spondylolisthesis without neural arch defect. The oblique views show the neural arch intact. The lateral view shows a slight anterior displacement of L.4 and marked narrowing of the intervertebral space between L.4 and L.5.

* Based upon a paper read to the Orthopaedic Section of the Royal Society of Medicine in November 1949.

## ETIOLOGY

There is no recorded instance of a patient with a radiologically normal spine who subsequently developed this condition. Any statement as to etiology must therefore be a matter of conjecture based on the findings and progress of established cases. Examination of the radiographs in this series provides some evidence for the pathogenesis of the slip. The body-weight transmitted through the spinal column tends to displace the lumbar vertebrae forwards, but this force is resisted by the soft tissues and the posterior articulations. These posterior joints may lie in one of three planes—sagittal, coronal or oblique. When the joints are in the sagittal plane the production of an anterior dislocation presents no mechanical problem. In such instances, after disc degeneration, the body-weight could displace the vertebra forwards. Although this undoubtedly occurs, it is unusual, because the posterior joints seldom lie in a true sagittal plane. Though they may be sagittal posteriorly, they hook

FIG. 2
In the normal third lumbar vertebra the angle ($\alpha$) formed between the pedicle and the inferior articular facet is about 90 degrees. In the displaced fourth lumbar vertebra this angle ($\beta$) is opened out to about 145 degrees.

round anteriorly—like the letter **J**—and form bony bars resisting forward displacement. In the same way joints lying in an oblique or in the coronal plane act as bony bars preventing dislocation, which can occur only by over-riding or fracture of the facets.

Normally the plane of the inferior articular facet is at right angles to the pedicles and over-riding is virtually impossible. Junghanns, however, pointed out that in his specimens of " pseudo-spondylolisthesis " the angle between the pedicle and the inferior articular facet approached 180 degrees (Fig. 2). This alteration in angle between the pedicle and the inferior facet may be one of the many congenital anomalies found in this region. This is the essential lesion, and when it is present the anterior dislocating force is resisted only by the soft tissues

and mainly by the intervertebral disc. It may be supposed that the abnormal strain eventually causes disc degeneration, which leads to an alteration in the axis of flexion and extension of the adjacent vertebrae. Calvé and Galland (1930) demonstrated that in the lumbar spine this axis normally passes through the nucleus pulposus, whereas after disc degeneration it passes through the posterior joints so that—except in the rare instances when they are sagittal—flexion and extension movements cause rocking at these joints (Fig. 3). This abnormal movement probably accounts for the gross osteoarthritis of the posterior joints seen in the later stages of the condition. As the osteoarthritis progresses, the body-weight produces

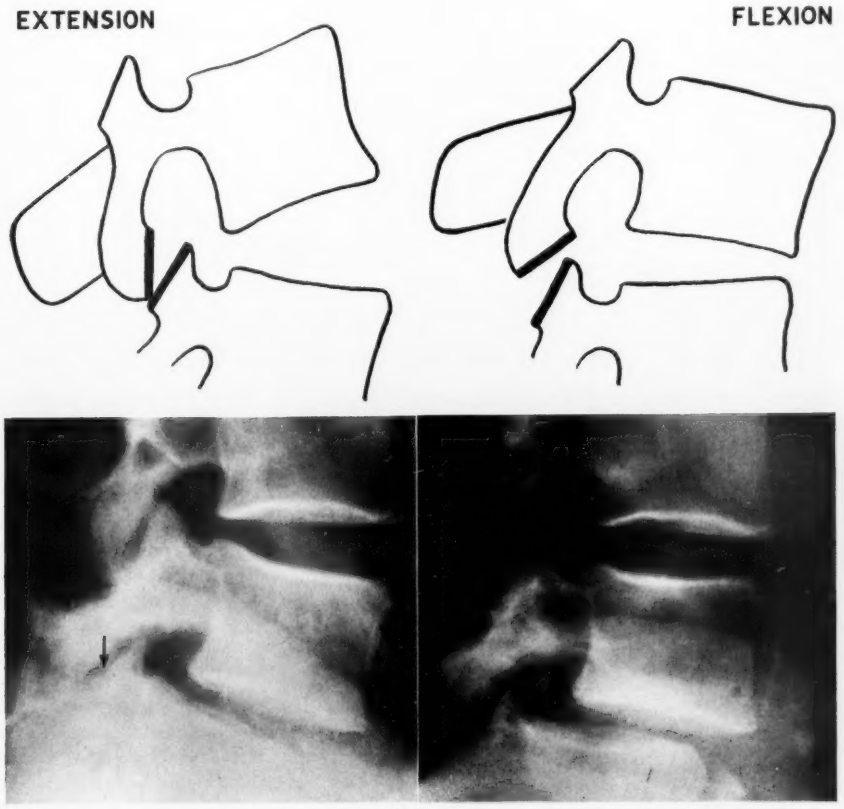


FIG. 3

*Above*—Diagram to show the rocking movement at the posterior intervertebral joints on flexion and extension in the presence of disc degeneration. *Below*—Radiographs of the lumbar spine in a case of "pseudo-spondylolisthesis," in extension and in flexion. Note how the posterior facet rocks open in flexion.

subluxation at these joints and the superior vertebra slips forward, producing a spondylolisthesis. The anterior displacement is increased on flexion, so that flexion and extension movements of the lumbar spine produce not only rocking but also a backward and forward movement of the body of the affected vertebra like the action of a horizontal piston (Fig. 4). This piston movement must cause considerable injury to the posterior joints, which become progressively more disorganised and allow increasing forward dislocation.

At the same time secondary changes occur in the rest of the spine. There may be increased lumbar curvature, lumbo-dorsal osteoarthritis, occasionally pelvic rotation and eventually generalised lumbar arthritis. In the later stages no appreciable movement takes place between the displaced vertebra and the one below it, and it is probably the secondary changes in the spine which now account for the patient's symptoms.

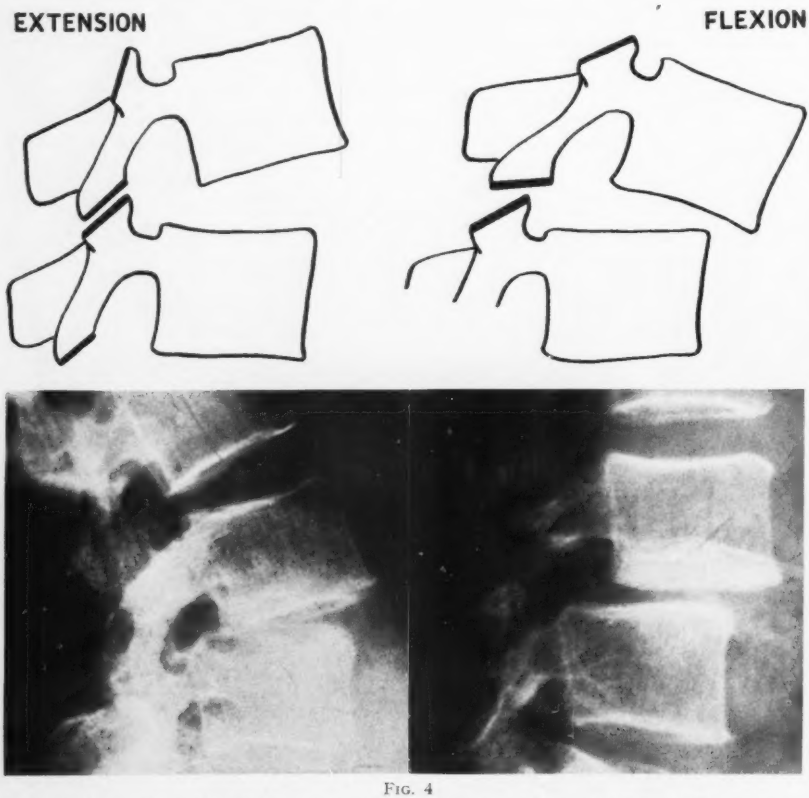


FIG. 4

Diagrams and radiographs of the lumbar spine in a case of "pseudo-spondylolisthesis" in extension and in flexion. Note how the vertebral body shifts forwards on flexion.

With regard to the secondary lumbo-dorsal arthritis, it is probable that the mechanical insufficiency gives rise to localised muscle spasm of a protective nature, and that flexion and extension movements of the spinal column then take place largely at the lumbo-dorsal junction, causing excessive strain and, later, disc degeneration and osteoarthritis. This association of a lesion in the lower lumbar area with osteoarthritis of the lumbo-dorsal junction is seen in other forms of mechanical insufficiency such as disc degeneration and spondylolysis, and is an important factor in determining treatment.

Stewart (1935) has stated that the alteration in the angle between the inferior articular facet and the pedicle is secondary to the osteoarthritis of the zygo-apophysial joints. Usually, the osteoarthritis of the posterior joints is obvious by the time the symptoms are severe enough to compel patients to seek advice, but in one case in this series a slip was

present before there was any radiographic evidence of such osteoarthritis. This case, though a single one, lends support to the view that the change in the angle between the pedicle and inferior articular facets is the primary condition.

It has also been suggested that the anterior displacement is merely the result of disc degeneration. However, because of the forward inclination of the superior anticular facets, disc degeneration by itself produces not an anterior displacement but a downward and backward movement of the vertebral body (Fig. 5).

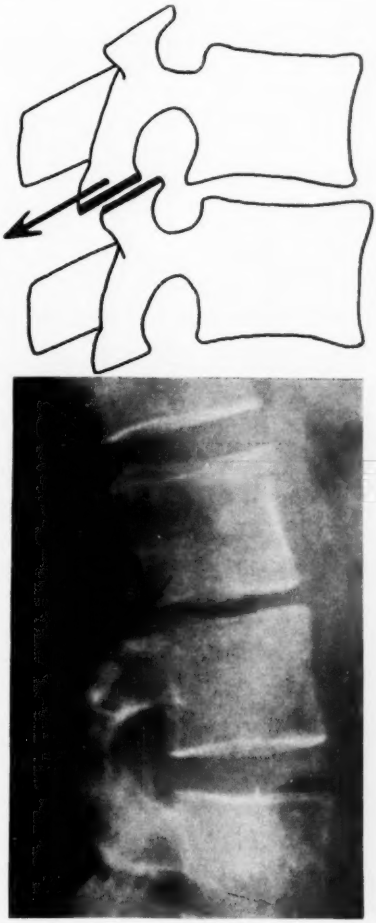

FIG. 5

The minor degree of retro-spondylolisthesis that is seen with disc degeneration.

## THE CLINICAL PICTURE

The symptoms and signs of any one cause of backache are so various and variable that it is impossible to establish the clinical picture of this type of spondylolisthesis from such a small series (see Table I).

In general it may be said that there are three groups of symptom-complex: 1) backache, with or without sciatica, but with no signs of nerve root compression; 2) sciatica, with or without backache, and with evidence of nerve root compression; and 3) symptoms of cauda equina compression.

*Symptoms*—In five patients the onset of symptoms was sudden, four having had acute sciatica after heavy lifting. More commonly, however, the patients gave a history of a gradual onset of central low back pain radiating transversely, nagging in character, intermittent at first but later becoming more persistent. The backache was aggravated by exercise and commonly was worse on getting up after rest. Many patients stated that the backache was aggravated by lying flat on the back. In twelve patients the backache was followed after some years by sciatica, which was bilateral in six of the twelve, and it was this new symptom that caused them to seek advice.

*Signs*—Examination showed that flexion of the lumbar spine was restricted, with tenderness on deep pressure over the fourth spinous process and over the supra-spinous ligament between L.4 and L.5. In many cases there was another area of tenderness over the lumbo-dorsal junction, which, as noted earlier, is a common site for secondary osteoarthritic changes.

There were signs of nerve root compression in eleven patients. The ankle jerk was absent in all of these, and in two the knee jerk was absent also. One patient had anaesthesia in the distribution of the fourth lumbar dermatome and in two there was marked weakness of the quadriceps, tibialis anterior and tibialis posterior. In one patient who had never suffered from backache or sciatica the presenting symptom was a dragging of the left foot.

Cauda equina compression is rare and there was no example of it in this series. It has been included in the group of symptom complexes because cauda equina lesions associated

with spondylolisthesis have been recorded in the literature, and it seems likely that many of the spinal lesions have been examples of so-called pseudo-spondylolisthesis. Sir Arbuthnot Lane (1893) was the first to record such a case. The patient suffered from backache and a progressive paraplegia which made her unable to walk. Lane made the clinical diagnosis of spondylolisthesis and performed a laminectomy. The spinous process and the lamina of the fifth lumbar vertebra were found to be displaced forwards and severely compressing the cauda equina. This forward displacement of the spinous process and the lamina excludes spondylolisthesis due to a neural arch defect, and Lane further remarked that no solution of continuity of the neural arch could be seen at any point on either side. Similar cases were later reported by Goldthwait (1911) and Ryerson (1915).

TABLE I

SUMMARY OF TWENTY-TWO CASES

| | |
|---|---|
| **Sex** . . . . . | 7 male<br>15 female |
| **Duration of symptoms** . | 3 months (shortest)<br>15 years (longest)<br>(*Average, 7 years*) |
| **Classification of symptoms** | Backache only—7 cases<br>Backache and unilateral sciatica—6 cases<br>Backache and bilateral sciatica—6 cases<br>Sciatica only—2 cases<br>" Drop-foot "—1 case |

*Radiographic findings*—The fourth lumbar vertebra is most commonly affected, whereas neural arch defects are most commonly found in the fifth vertebra. In a series of 142 cases of spondylolisthesis reviewed for this study, thirty-eight were found to involve the fourth lumbar vertebra and *twenty-two of these had no neural arch lesion.* These findings suggest that anterior displacement of the *fourth* lumbar vertebra is as commonly due to subluxation of the posterior joints as to a defect in the neural arch. It is difficult to assess the incidence of spondylolisthesis of the fifth lumbar vertebra without neural arch defect, because satisfactory radiography of the pars interarticularis is difficult. Many cases of anterior dislocation of the fifth lumbar vertebra are diagnosed as spondylolisthesis in the ordinary sense of the term without a defect being seen, and it is quite possible that in some of these the neural arch is intact.

The anterior displacement was in no case great. In one instance the vertebral body had moved forward 1·0 centimetre, but the average displacement was only 0·6 centimetre. There was usually marked osteoarthritis of the posterior joints between the fourth and fifth lumbar vertebrae. The osteoarthritis may be confined to these joints, but often by the time the patient seeks advice degenerative changes can be seen in all the lumbar posterior joints.

As the average age of patients with this condition was sixty years, the usual radiographic appearance was one of an osteoporotic, osteoarthritic spine with slight anterior displacement of the fourth lumbar vertebra but with no defect of the arch revealed by the oblique views.

## TREATMENT

Treatment is most easily discussed under the headings of the three groups of symptom-complex previously mentioned.

**Group I.** *Backache with or without sciatica, but with no signs of nerve root compression*—The presence of " pseudo-spondylolisthesis " indicates a mechanically unstable spine which, if left untreated, will lead to progressive lumbar osteoarthritis, and possibly to nerve root compression or even to compression of the cauda equina. Seen early, therefore, it calls for

spinal fusion. Since there is no neural arch defect there is no need to fuse three vertebrae as for the common type of spondylolisthesis. Adequate stability can be obtained by fusion of the displaced vertebra to the one below it (Fig. 6). In the later stages, however, when there are marked secondary changes, localised spinal fusion will relieve the symptoms from one source only and may indeed aggravate the others, so that conservative treatment is best.

FIG. 6
Spinal fusion of L.4 and L.5 for spondylolisthesis without arch defect.

**Group II.** *Sciatica with or without backache, and with signs of nerve root compression*—Nerve root compression can arise in three ways: (*a*) *Compression in the intervertebral foramen*—Forward displacement of a vertebra is associated with narrowing of the two inferior intervertebral foramina. The osteoarthritis which occurs in the posterior joints may be associated with marked capsular thickening and occasionally there is spur formation on the posterior edge of the displaced vertebral body. Any one or all three of these factors may play a part in root compression (Fig. 7). (*b*) *Compression by the lamina of the displaced vertebra*—This type of compression occurs only in the presence of an intact neural arch; otherwise only the vertebral body slips forward, and the lamina remains *in situ* (Fig. 8). (*c*) *Compression of a nerve root by an associated prolapsed intervertebral disc.*

Whatever the cause of nerve root compression, if the symptoms are severe enough laminectomy with subsequent spinal fusion is indicated.

**Group III.** *Signs of compression of the cauda equina*—Laminectomy would of course be imperative and should be followed by spinal fusion.

## SUMMARY

Spondylolisthesis without a defect in the neural arch, the " pseudo-spondylolisthesis " of Junghanns, usually affects the fourth lumbar vertebra. The essential lesion is an increase in the angle between the inferior facets and the pedicles which allows subluxation at the inferior joints. The forward displacement averages less than one centimetre.

It commonly produces a clinical picture of backache and sciatica, but may present with a " drop foot," and in unusual instances compression of the cauda equina may occur.

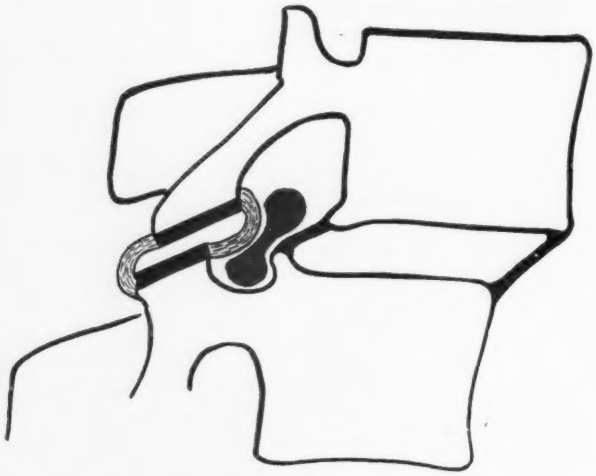

FIG. 7

A diagram to show the mechanism of nerve root compression in spondylolisthesis without arch defect.

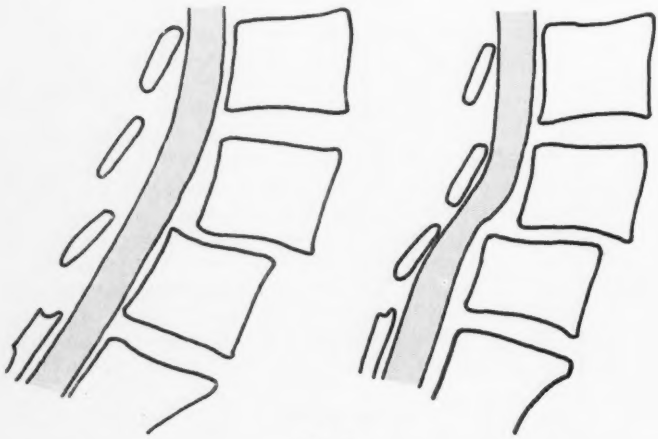

FIG. 8

In spondylolisthesis with an arch defect (left), because the lamina remains *in situ*, the spinal canal is widened at the site of the slip and cauda equina compression does not readily occur. In spondylolisthesis without arch defect (right) the lamina is displaced with the vertebral body.

Patients seen in the early stages without signs of nerve root compression are best treated by localised spinal fusion. Late fusion may afford no relief because of secondary changes in the spine, but these patients obtain some benefit from a corset. Laminectomy is indicated for severe symptoms in patients who show signs of nerve root compression; it should be followed by spinal fusion.

I would like to thank the surgeons of the Royal National Orthopaedic Hospital for access to their clinical material and, in particular, Mr P. H. Newman for his help and encouragement.

## REFERENCES

CALVÉ, J., and GALLAND, M. (1930): Revue d'Orthopédie, **3e** série, **17,** 5.
FRIBERG, S. (1939): quoting Chiari (1892), Lambl (1858) and Neugebauer (1889) in Acta Chirurgica Scandinavica, **82,** Supplement 52.
GOLDTHWAIT, J. E. (1911): Boston Medical and Surgical Journal, **164,** 365.
HALLGRIMSSON, S. (1941): Acta Orthopaedica Scandinavica, **12,** 309.
JUNGHANNS, H. (1930): Archiv für Orthopädische und Unfall-Chirurgie, **29,** 118.
LANE, W. ARBUTHNOT (1893): Lancet, **i,** 991.
RYERSON, E. W. (1915): Journal of the American Medical Association. **64,** 24.
STEWART, T. D. (1935): Journal of Bone and Joint Surgery, **17,** 640.

# CHERUBISM—A FAMILIAL FIBROUS DYSPLASIA OF THE JAWS*

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Bone dystrophies paint queer and irregular pictures throughout the skeleton and have been reported in most bones. A familial character is not often apparent. Involvement of both the superior and inferior maxillae in several members of the same family is most unusual and merits a detailed record.

Three members—two boys and a girl—of a Jewish family of Russian extraction have been under observation since 1931 for a strange deformity of both jaws. Detailed clinical and radiographic studies have been made from an early age, and the condition was reported provisionally as a familial, multilocular cystic disease of the jaws, probably of odontogenic origin (Jones 1933, 1938). Seeking relief from their grotesque deformity, the children were operated upon by one of us (J. G.) in 1943–4. Pathological examination disclosed the true nature of the condition and after a four-year period of observation the material is ready for a full review.

In their early years the children showed a marked fullness of the cheeks and jaws; a slight upward turning of the eyes revealed a white line of sclera beneath the iris (Figs. 1 and 2). There was also noticeable swelling of the submandibular regions. To describe the exaggerated chubbiness of their features, Jones in 1933 coined the term "cherubism." The children were active and intelligent with normal interests and social curiosity.

Both jaws were felt as hard masses bulging outwards to form a bilateral, painless swelling of the face. The deciduous teeth were irregularly placed and many were missing. The alveolar ridges, which were very wide, in the upper jaw gave rise to a narrow V-shaped palate. The submandibular lymph nodes were enlarged; histological examination of one of them showed thickening of the capsule and fibrosis of the gland. Whether these changes represented a subacute inflammatory response secondary to the mechanical irritation of the expanding cysts or whether they formed a part of the dysplasia was uncertain. However, the swelling of the glands regressed and was not demonstrable during adolescence. Radiographic examination of the other bones showed no abnormality. *Examination of the blood* in the early active phase of the disease showed no marked changes. The red and white cell counts, haemoglobin and blood urea were normal and the Wassermann tests were negative. In the case of the girl the calcium and phosphorus were within normal limits, but in the oldest boy there was an inconstant increase, the highest readings being 11 milligrammes calcium per 100 cubic centimetres with 7·6 milligrammes phosphorus, and 12·4 milligrammes calcium with 8·68 milligrammes phosphorus. Again in the case of the eldest boy, blood-protein estimation showed normal values for plasma volume, total plasma protein, fibrin, globulin, albumin, and albumin-globulin ratio at one examination; at another time the total plasma protein was increased to 11·6 (normal 6·0–8·0) and albumin to 9·4 (normal 4·0–5·8). It is doubtful whether any diagnostic significance can be attached to these variations.

* Paper read by John Gerrie before the American Society of Maxillo-facial Surgeons, Minneapolis, October 1948.

FIG. 1

The three oldest children in 1931. *Left to right:* A. X., aged six; B. X., aged five and C. X., aged four years. Note the full rounded cheeks, the upcast eyes and the cervical adenopathy, especially in the two younger children.

FIG. 2

All five children in 1937. *Left to right—top:* C. X., aged ten years; A. X., aged twelve years; *below:* B. X., aged eleven years; G. X., aged eighteen months; F. X., aged seven years. In the three older children the cervical adenopathy has regressed but the facial deformity seems to be increasing still.

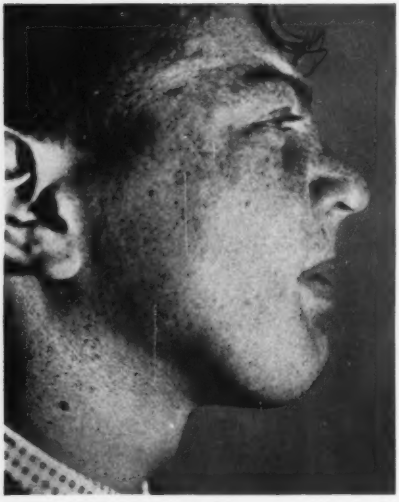

FIG. 3

FIG. 4

FIG. 5

FIG. 6

The oldest son, A. X. The top pair of photographs was taken in April 1944 before operation; the bottom pair in October of the same year after operation. Of the three oldest children, A. X. showed the least deformity, and there may have been some regression in his case.

FIG. 7

FIG. 8

FIG. 9

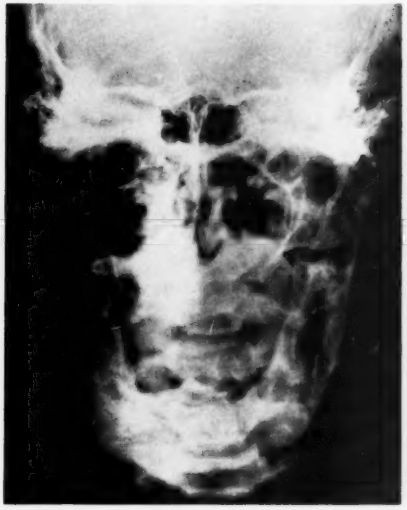

FIG. 10

Serial radiographs of A. X. Figure 7 was taken in 1931 at six years and Figure 8 in 1937 at twelve years; Figures 9 and 10, taken three years after operation, show no evidence of recurrence.

FIG. 11

FIG. 12

FIG. 13

FIG. 14

The only daughter, B. X. The top pair of photographs was taken in June 1943, before operation when there was no evidence of any regression. The bottom photographs were taken in April 1944 after operation.

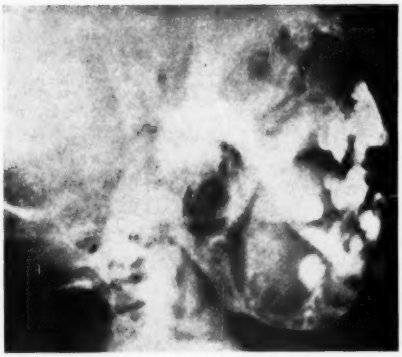

FIG. 15

FIG. 16

FIG. 17

FIG. 18

Serial radiographs of B. X. Figure 15 was taken in 1931 at five years, and Figure 16 in 1937 at eleven years; Figure 17 was taken in 1942 before operation, at sixteen years, and Figure 18 five years after operation.

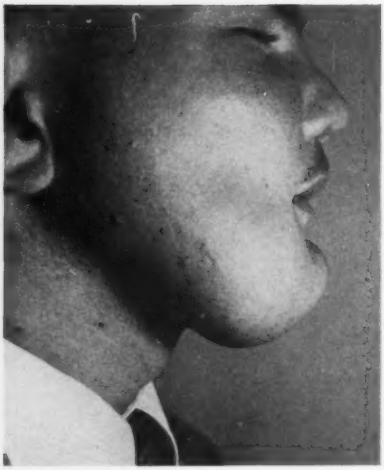

FIG. 19

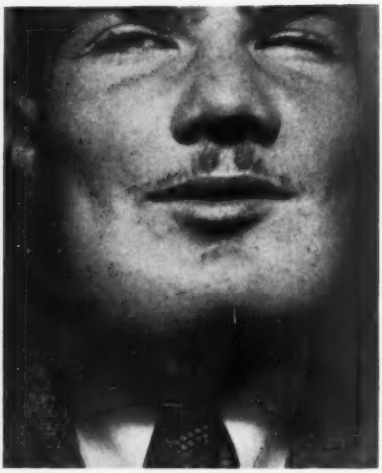

FIG. 20

FIG. 21

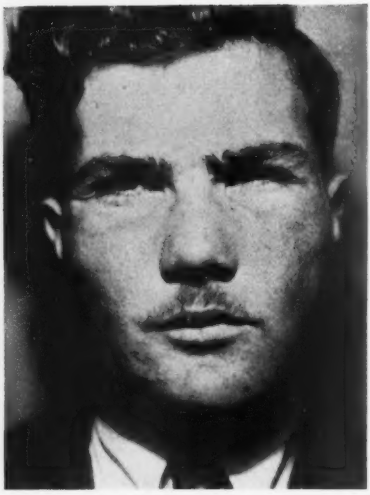

FIG. 22

The second son, C. X. The top pair of photographs was taken before operation in September 1943, when he was sixteen; the bottom pair in April 1944, after operation. C. X. showed the greatest deformity, in which there was no evidence of spontaneous regression.

FIG. 23

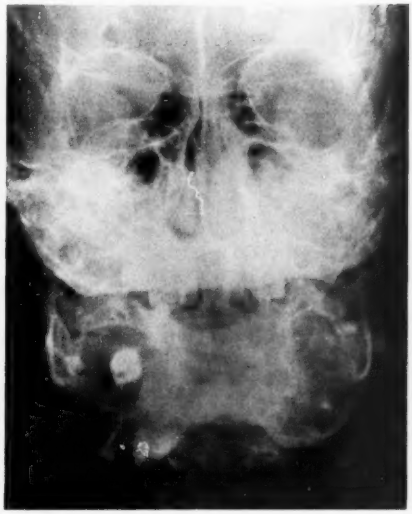

FIG. 24

FIG. 25

FIG. 26

Serial radiographs of C. X. Figure 23 was taken in 1931 at four years and Figure 24 in 1943 before operation, at sixteen years; Figures 25 and 26 were taken in 1947 after operation.

FIG. 27

A radiograph of the left mandible of the patient F. X., taken in 1947 when he was sixteen years of age. A roughened area can be seen in the lower molar regions; this appearance, which was also seen in the right mandible, may indicate a minimal involvement by the same process.

FIG. 28

A radiograph of the right mandible of the patient G. X., taken in 1947 when he was eleven years of age. Minimal cystic involvement of the lower molar area can be seen, and this was bilateral. Similar appearances had been noted in 1938 at the age of seven years.

FIG. 29

The three oldest children in 1947, three years after operation. *Left to right*: C. X., aged twenty; B. X., aged twenty-one; and A. X., aged twenty-two. The maxillary regions are still full, but the cherubic appearance is gone.

FIG. 30

All five children in 1947. G. X. (*lower centre*) has a minimal cystic involvement of the molar areas; F. X. (*lower right*) has only a roughening of the molar alveloar process.

By the time the three oldest children had reached the ages of fifteen, sixteen and seventeen years respectively, the cherubic appearance had developed to the point of being grotesque, and was worrying both to the children and the parents. The eldest boy showed least deformity, and it was felt that there had been some regression in his case (Figs. 3 and 4).

**Findings at operation**—Operation was undertaken on the girl when she was sixteen years of age. Intra-oral operation upon the more involved side of the jaw was decided upon with a view to improving her appearance and determining the exact nature of the condition. The incision was made from the lower labial fraenum, along the crest of the alveolar process to the anterior border of the ascending ramus of the mandible. The flap was laid back and dissection continued down to the involved tissue. There was no periosteum as such over the tumour bosses, but fatty fibrous masses with no capsule were encountered, escaping from the bone and mingling with the tissue of the cheek. Dissection was carried out around these masses with scalpel and scissors, and the whole side of the mandible was exposed. The bone was sclerotic and thick and not of the egg-shell character expected. There was no demarcation into cystic areas. The fatty fibrous tissue seemed to blend into tougher tissue and hard bone, without demarcation. Much of the abnormal tissue was removed in such a way as to clear the outer aspect of the mandible down to bone but to leave the thick lingual and inferior parts bulging into the floor of the mouth. Some of the tissue was teased out of the ramus with curettes. In no way was the operation a complete removal of all the involved tissue, nor was the upper jaw operated on. The cheek flap was collapsed against the bone, a drain inserted and black silk sutures placed. The other side of the mandible was operated upon fifteen days later.

The cosmetic result was so gratifying to both patient and parents that one-stage operations were subsequently performed on the two boys. A year later, removal of one of the inferior bony bosses from the girl's mandible was carried out by the same route. A break in the skin left a submandibular scar and some flattening which was later corrected by a cartilage insert.

**Progress**—The three patients have been examined clinically and radiographically four years after operation. There has been no evidence of recurrence of the swellings. The general appearance of each patient was almost normal and we considered that the condition was inactive and probably regressing (Figs. 29 and 30). The youngest patient, *C. X.*, was killed in 1948 in a motor accident.

**Histology**—The tissue removed at the first operation showed a cellular structure with multinucleated giant cells of the osteoclastic type (Figs. 31 and 32). Throughout the section there were fairly numerous and well-formed capillary blood vessels lined with large endothelial cells. Several small haemorrhages and scattered deposits of granular haemosiderin were observed but no xanthoma cells. *The stroma* varied in different parts. Generally it was of a spindle cell fibroblastic type with a variable amount of collagenous stroma. In some areas it was entirely so, and arranged in intertwining bundles with a moderate blood supply. In other places a similar stroma contained large numbers of giant cells, while in still other places the tissue was composed largely of giant cells with little stroma, dilated capillary-like blood spaces lined with endothelium and considerable haemorrhage in the tissues. *The giant cells* contained from two to fifty nuclei. Where cortical bone was included in the sections it showed a variable degree of lacunar absorption and replacement by connective tissue blending into the periosteum. The medulla and most of the cortex was in some areas largely replaced by this dysplastic bone tissue.

In many places the tissue resembled giant-cell tumour of bone, but the stroma was more generally of the spindle-cell variety and showed more collagenous intercellular deposits; in certain parts it was entirely fibrous, with no giant cells. It was considered that the process was a fibrous dysplasia of bone with a partial shift to the osteolytic phase of bone metamorphosis with numerous giant cells and increased vascularity.

**Family History**—All the living members of the family were examined in October 1947. Brief case histories follow.

FIG. 31

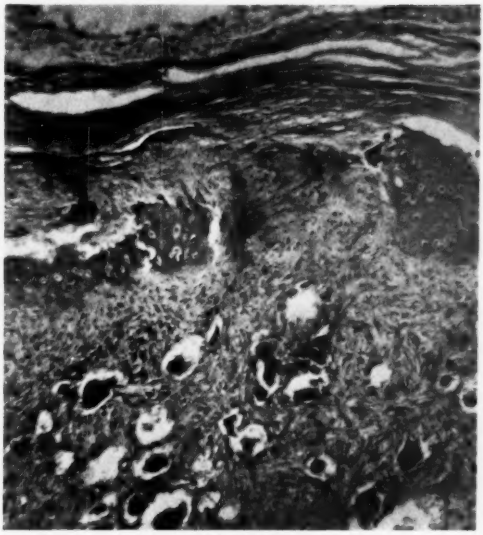

FIG. 32

Figure 31—Photomicrograph taken from a typical fibrous area in the medulla, showing the intertwining bundles of fibrous tissue (×80). Figure 32—Photomicrograph taken from a typical area at the periphery of a specimen, showing in the lower half the medullary part which consists of fibrous tissue with numerous multinucleated giant cells. Note the absence of giant cells in the subcortical fibrous zone. Across the centre the remains of the cortex undergoing lacunar absorption and replacement by fibrous tissue can be seen. In places it has been entirely absorbed and replaced by fibrous tissue which is continuous with that of the subcortex and with the overlying periosteum, which also shows marked cellular proliferation and fibrosis in its deeper layer (×100).

*D. X.*—the father, aged forty-six years. College education, actively engaged in business. Jewish parents had migrated to Canada from Russia. Knew of no familial deformity. A well-developed male of medium stature with no apparent abnormalities. Teeth and jaws normally developed.

*E. X.*—the mother, aged forty-two years. Hebrew parents had migrated to Canada from Russia. Knew of no familial deformity. A well-developed woman of medium stature with no apparent abnormalities. Teeth developed normally until the onset of caries early in married life; now wears full dentures. Normal maxillae.

*A. X.*—the oldest child, a son, aged twenty-two years (Figs. 3 to 10). Born in July 1925. Puberty at seventeen years. Teeth were poorly developed and irregular, and all had been extracted by nineteen years (full dentures now worn). A heavy well-developed young man with many freckles and moles on the face, arms and back. Apparently normal at birth. Deciduous teeth were present at one and a half years. He had some thymic attacks early in the second year of life. A radiograph failed to show any definite enlargement of the thymus but the symptoms cleared up under X-ray therapy. At that time the mandible appeared normal radiographically. About the end of his second year the cheeks and jaws began to enlarge and the submandibular lymphatic glands became swollen. The swelling became more noticeable during the next two years but did not later increase. When he was twelve years old the lymphatic glands were barely palpable. There were ten teeth placed irregularly in the upper jaw, and five in the lower jaw. Several partly developed teeth had been shed. Although it appeared clinically that some improvement had occurred, radiographic examination showed that in fact the lesion had progressed.

Operation was performed in one stage when he was eighteen years old. Dissection and block removal of the involved tissues were performed down the side and around the lower border of the mandible. The result was gratifying, and there has been no clinical or radiographic evidence of recurrence after four years.

*B. X.*—the second child, a daughter, aged twenty-one years (Figs. 11 to 18). Born in August 1926. The most severely affected of the three oldest children and very conscious of her deformity. Puberty was late and menstruation began at fifteen years.

Apparently normal at birth. She cut her first tooth at eleven months, but the lower jaw never had a full complement of deciduous teeth. At five years she had eight deciduous and two permanent teeth. Her cheeks and lower jaw began to enlarge about the beginning of her third year. During the fifth year she

showed a rather marked secondary anaemia and felt poorly and listless. At this time the submandibular lymphatic glands increased in size. There was no rise in temperature and there were no changes in the white blood cells. Radiographic examination showed cystic changes in the mandible, the cysts being larger and the walls more finely marked than in the case of her elder brother. After administration of iodine and iron the general health improved and the lymph glands receded to one-half their former size. At the age of eleven years the lower jaw was larger, but the lymphatic glands were quite small. Radiographs showed that the cyst-like areas were less noticeable and that normal bone was increasing. As with her elder brother, the swelling of the upper jaw was less noticeable than formerly. There were seven upper teeth and four lower teeth, all irregularly placed. She had developed, on one or two occasions, an epuloid tumour along the gum margin of the lower jaw. Microscopic examination of one of these tumours showed granulation tissue infiltrated with inflammatory cells, many of which were polymorphs. At the age of sixteen years the clinical appearance was grotesque and radiographs showed massive involvement of bone (Fig. 17). No glands were palpable in the neck. The operation on this patient has already been described. The result is completely satisfactory and she is now employed as a secretary.

*C. X.*—the third child, a son, aged nineteen years (Figs. 19 to 26). Born in December 1927. Puberty at age of twelve. Normal intelligence and average stature. Normal at birth. He cut his first teeth at six months and had all his temporary teeth; at the age of four years he still had seventeen baby teeth. About the end of the second year his cheeks and lower jaw began to enlarge. At the age of four the lymphatic glands in the submandibular regions became much enlarged and did not begin to recede until about three years later. Radiographs showed changes in the mandible similar to those of his elder brother (Fig. 23). Six years later there was noticeable progression of the condition, the cystic areas being larger and the jaw much more massive. The lymphatic glands were palpable as hard, firm nodules about the size of peas. At the age of sixteen years he showed the same unusual massive involvement as did his sister (Fig. 24). Otherwise he was normal, and no glands were palpable in his neck. Operation was undertaken in one stage. The cysts were slightly less extensive than those of his sister's case, but differed in no other way. The result was very satisfactory and no further revision has been indicated.

*F. X.*—the fourth child, a son, aged sixteen years. Born in February 1931. A normally developed boy. Puberty at fourteen. Clear skin and no freckles. He has had carious teeth and has lost several, but they were otherwise normally developed. The jaws are normal clinically but a roughness of the alveolar border in the lower retromolar area was seen in the radiographs and may signify a minimal involvement by the same familial condition.

*G. X.*—the fifth child, a son, aged eleven years. Born in October 1936. At eighteen months, radiographs showed early evidence of the disorder. There was a bilocular cyst-like area behind the last molar tooth on the left side; on clinical examination, a suspicious bulge was palpable at this point. The other side of the jaw was normal.

The child now presents a normal appearance. Palpation of the jaws reveals a tendency to fullness of the mandible in both molar regions and angles. There is slight enlargement of the lymph glands. Radiographs show evidence of the same familial condition on both sides of the mandible, more marked on the left side. Has had most of his molar teeth extracted for irregularity.

## DISCUSSION

On reviewing this interesting familial condition, there is some irreconcilable difference of opinion among the authors. Gerrie considers, with Pritchard, that it is probably a bone dysplasia, to which the aberrant dental condition is incidental. Jones, on the other hand, feels that a lesion which is found only in the teeth-bearing areas and which is not present in any other bone must have some relationship to the development and growth of the teeth. Thoma (1948), reviewing Jones's work, doubted the dental origin of the anomaly and thought it was more likely to be one of the bone dysplasias.

Multiple dental anomalies are uncommon. Beyrent (1938) reported multiple dentigerous cysts in four members of one family. Ivy (1939) discussed multiple dentigerous cysts with special reference to their occurrence in siblings, and reviewed several examples from the literature. Dentigerous cysts are the most common multiple anomalies occurring in the jaws but they are easily demonstrable radiographically as dental anomalies and their pathological features are well defined. Cystic adamantinoma may present similar radiographic appearances but the clinical course and the pathological characteristics of adamantinoma are entirely different.

Jones (1938) noted that in the cases under discussion many of the cystic areas contained

teeth which had erupted, usually in an irregular manner, and that most of them had been shed. Several cysts which did not contain teeth extended well up the rami of the lower jaws. He assumed that those cysts which contained no teeth represented an abortive attempt at multiple formation of teeth in which the anlage of the accessory teeth had failed to evolve complete organs; the tooth buds degenerated and cysts were produced.

The only known authentic case of a similar type seems to be a patient of Dr P. J. Thomas of Savannah, Georgia, reported in some detail by Jones (1938). The patient was a boy aged eleven years. The radiographs were very similar to those of our cases; the cherubic appearance and the lymphoid hyperplasia were absent, however, and the condition regressed with age. Dr Thomas was able to trace the disorder through an unbroken line of five generations to the great-great-grandmother of the patient. In our cases the genetic history was disappointingly negative. Jones (1938) noted the possibility that the mating of these parents might be the original source of a new line of descendants with this peculiar condition.

## SUMMARY

1. A condition of fibrous dysplasia of the jaws occurring in four brothers and a sister has been under observation since 1931.
2. Three of the five patients have been operated upon for correction of grotesque deformity, with satisfactory results.
3. The pathological nature of the disorder is discussed.

## REFERENCES

BEYRENT, J. REESE (1938): Multiple Dentigerous Cysts in Four Members of One Family. Journal of the American Dental Association, **25,** 623.
IVY, ROBERT H. (1939): Multiple Dentigerous Cysts. Annals of Surgery, **109,** 114.
JONES, W. A. (1933): Familial Multilocular Cystic Disease of the Jaws. American Journal of Cancer, **17,** 946.
JONES, W. A. (1938): Further Observations Regarding Familial Multilocular Cystic Disease of the Jaws. British Journal of Radiology, **N.S. 11,** 227.
THOMA, KURT H. (1948): Oral Surgery. 2 volumes. London: Henry Kimpton.

# OSTEOCHONDRITIS DISSECANS OF THE ELBOW JOINT

## A Clinical Study

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The term osteochondritis dissecans is used in this paper to describe an apparently non-infective condition in which a portion of articular cartilage and underlying bone is slowly separated from its bed. The separation, which is at first partial, may be completed with the formation of one or more loose bodies.

It is commonly believed that the incidence of osteochondritis dissecans in the knee is very much higher than in any other joint; according to Conway (1937) the knee is affected in 85 per cent of cases. The British and American literature has only scant and isolated reference to incidence in the elbow joint, where the condition is regarded as somewhat of a rarity (Murphy 1936). Continental writers, on the contrary, have for the past twenty years recognised a higher incidence in the elbow than in the knee (von Staa 1930, Lohr 1929). We believe that in this country the condition is no less common, and our purpose is to record its main features as we have found them in a study of thirty-eight cases.

### CLINICAL MATERIAL

During this investigation, the records of over ninety unselected cases of loose body in the elbow joint were studied from hospitals in the Liverpool area. Reviewing the operation records of twenty years at the Liverpool Royal Infirmary, we found that arthrotomy for loose body was far more frequently performed on the elbow than on the knee. In selecting cases for review we were at pains to exclude all doubtful cases and, when loose bodies have been the presenting feature, care has been taken to exclude other possible causes. Thirty-eight cases (forty-four elbows) were accepted as undoubted cases of osteochondritis dissecans.

### CLINICAL FEATURES

**Age at onset**—A distinction must be made between the age of the patient at onset of the condition and the age at which he first seeks advice. The onset of the disease is variable but occurs principally in the second decade (Meyer-Wildisen 1932, 14–18 years; von Staa 1930, 15–22 years; Löhr 1930, 16–20 years), and in general at a much younger age than osteochondritis dissecans of the knee. The youngest patient in our series was eleven years of age; the highest incidence was at fourteen to fifteen years; a later onset, at nineteen or twenty, was seen occasionally. Schirmer (1925) described a case of osteochondritis dissecans in a man aged fifty-three years as "early."

**Sex**—There is a marked preponderance of the male sex—85 to 90 per cent in the published literature (von Tempsky 1930, von Staa 1930 and Kappis 1920). All but three of our thirty-eight patients were boys.

**Affected side**—In the unilateral cases the right elbow was involved twenty-seven times and the left five times. In six cases the condition was bilateral. Thus the right side was involved in 75 per cent of the total number of elbows affected. This striking predilection for the right elbow has been found by other writers (Christensen 1930, Kappis 1920, Schirmer 1925 and Tempsky 1930).

**Symptoms**—The clinical picture of the early case is very variable. Often the patient first complains of a diffuse dull pain or ache in the joint accompanied by a little stiffness; the

onset is insidious. Attention may be drawn to the condition by recent injury; a history of trauma was obtained in 41 per cent of cases, but in nearly all these we considered the injury was either too recent, too trivial or too remote to be relevant. The first symptom is often that of a loose body in the joint, and sudden spontaneous locking followed by pain and effusion in the elbow of an adolescent is pathognomonic of osteochondritis dissecans. Finally we would stress that the condition is often symptomless and discovered accidentally: so-called " slumbering " osteochondritis dissecans is, indeed, probably far commoner than is suspected.

**Signs**—The most constant early physical signs are limitation of extension of the elbow and palpable enlargement of the head of the radius. The absence of conspicuous synovial swelling distinguishes the condition from chronic infective lesions, particularly tuberculosis.

## RADIOGRAPHIC FEATURES

**Site**—The site of the lesion cannot be determined by clinical examination. In this series, radiography revealed a lesion either in the capitellum (forty elbows), in the head of the radius (two elbows), or in both (two elbows). It has been suggested (Morton and Crysler 1945, Ross 1947) that the supratrochlear septum may be the site of a primary lesion. It is true that a loose body may be found in a pit either in front of or behind the septum, but no case has been recorded in which the actual process of separation from this situation has been observed. Neither the olecranon nor the coronoid fossa is covered by articular cartilage, and in all Crysler's cases the loose bodies were shown to be covered by hyaline articular cartilage; furthermore, in at least one of their cases the published radiographs show clearly the enlargement of the head of the radius and flattening of the capitellum, which we associate with a previous lesion of the radio-humeral articulation. We conclude that the evidence for the occurrence of a primary lesion in the supratrochlear septum cannot be accepted.

**Early changes:** *The capitellum*—The so-called typical appearance of an island of subchondral bone surrounded by a zone of rarefaction, which is so often seen in the knee, hip and ankle, is rarely seen in the elbow; we have only one case in this category. Excellent illustrations of such a lesion have been published by Williams (1939) and by Miller (1936). Castay (1936) described a similar lesion but published no illustrations. In our experience the earliest changes are seen in the antero-posterior radiograph as a patchy rarefaction, with ill-defined limits,

FIG. 1

Early osteochondritis dissecans of the capitellum in a boy aged nineteen years. A single loose body was subsequently removed.

largely affecting the convexity of the capitellum (Fig. 1). The super-imposition of normal bone probably modifies the appearance. Less often the lesion is more easily seen in the lateral view (Fig. 2). The next most constant appearance is an irregular cyst-like change, which has been aptly likened by King (1932) to a series of signet rings of different sizes opening into the focus bed (Figs. 3 and 4), and which, as Burrows (1949) has pointed out, bears a resemblance to an early stage of Freiberg's disease of the metatarsal head. We believe that this represents a later, more defined phase of the patchy rarefaction, and that the separation of small fragments may now become evident. The shedding of multiple small

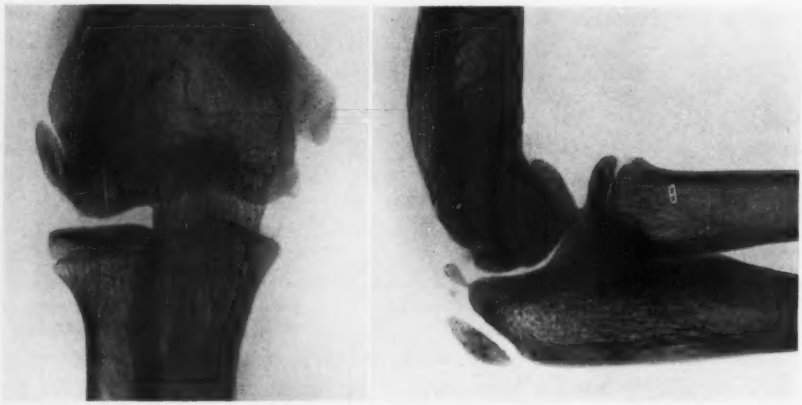

FIG. 2

Early osteochondritis dissecans in the right elbow of a boy aged fifteen. Flattening and irregularity of the capitellum are seen in the lateral view. Two loose bodies were later removed, one of which was completely detached and the other a hinged flap.

FIG. 3 FIG. 4

Figure 3—Osteochondritis dissecans with early change in the capitellum and head of radius. The patient was a boy aged fifteen complaining of pain and loss of extension in the right elbow. Figure 4—The same case nearly two years later. There is now extensive ragged destruction of the capitellum. At operation one completely detached loose body and a large hinged flap of articular cartilage were removed. The opposite elbow also developed osteochondritis dissecans with loose body formation.

fragments giving a ragged appearance is sometimes seen (Fig. 5). Yet another picture demands special description, namely the occurrence of a single, large, rarefied or punched-out area or cavity without any apparent sequestrum, very closely simulating the destruction of tuberculosis (Fig. 6). This diagnosis was, in fact, made in two such cases in our series, and disproved only by the subsequent progress. Somewhat similar cases have been illustrated by Christensen (1930). Sometimes a loose bone fragment is seen to lie close to its capitellar bed (Fig. 7). *The head of the radius*—In two patients in whom the major change was in the capitellum, irregularity and cyst-like changes were also observed in the head of the radius

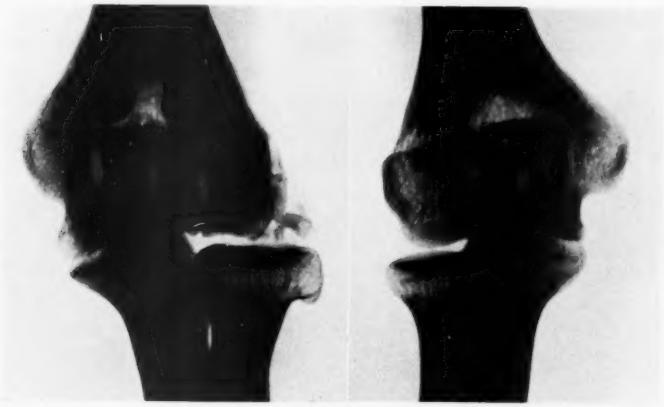

FIG. 5

Extensive destruction of the capitellum, marked enlargement of the head of the radius and formation of multiple loose bodies in the case of a girl aged fourteen years. The radiograph of the normal elbow is shown for comparison.

FIG. 6

The radiograph shows the right elbow of a boy aged fourteen, complaining of pain and limited extension. The capitellum shows a punched-out area; a large sequestrum of articular cartilage was removed.

(Fig. 3). In two other patients the lesion was confined to the head of the radius, and three identical cases have been reported by Nielsen (1931). The affected portion is the medial part of the convex rim of the radial head. Figure 8 shows such a lesion, and the radiographic appearance of the excised head is also shown. There is a separate bony fragment still covered by intact articular cartilage, and deep to this is an irregular cyst-like change affecting a wedge-shaped sector of the head. The appearance is very similar to that noted by Wolbach in osteochondritis dissecans of the knee (Jones and Lovett 1929).

**Late changes**—Whatever the original form of the lesion may have been, in the vast majority of cases presenting with loose bodies careful scrutiny of the radiographs will reveal the scars which are the hallmark of previous osteochondritis dissecans. The cyst-like appearance may remain (Fig. 9), or the eburnated irregular margins of the primary lesion may be seen in profile (Fig. 10), but the most constant feature of all is a flattening of the capitellum (Fig. 11).

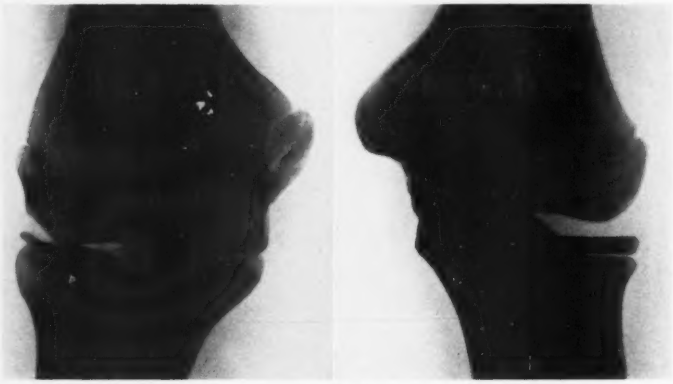

FIG. 7

The right elbow of a boy aged fifteen years; a radiograph of the normal side is shown for comparison. On the affected side there is irregular destruction of the capitellum and a detached loose body. Note the premature fusion of the lower humeral epiphysis and of the head of the radius.

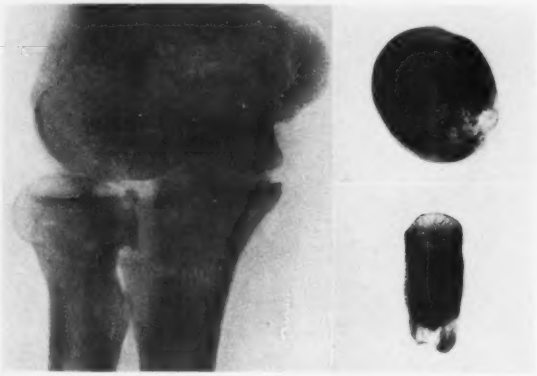

FIG. 8

Osteochondritis dissecans of the head of the radius in a boy aged sixteen years who had previously been operated on for osteochondritis dissecans of the capitellum on the opposite side. The radiographs show the appearance before operation and the state of the excised head.

This we have found to be present in 68 per cent of cases. It is also occasionally seen in normal elbows: in a group of fifty-four normal elbows flattening of the capitellum was noted in five (three persons). There are thus many patients, first reporting in the third decade, who have suffered from osteochondritis dissecans in an undetected form several years previously, and whose first important symptoms arise from the locking of a loose body. Secondary osteoarthritis commonly develops at a later age and may be wrongly regarded as the cause rather than the result of loose bodies. If the osteoarthritic changes are severe it may be difficult to distinguish between a primary osteoarthritis and one secondary to a previously undetected osteochondritis dissecans. The general distortion of the shape of the joint which occurs in severe osteochondritis dissecans does not limit itself to the capitellum and the head of the radius. As noted by King (1932), the greater sigmoid cavity of the ulna may be enlarged and deepened with a curious angular appearance (Fig. 12).

FIG. 9

A late case of osteochondritis dissecans, showing an irregular flattened capitellum, an enlarged head of radius and a single large loose body.

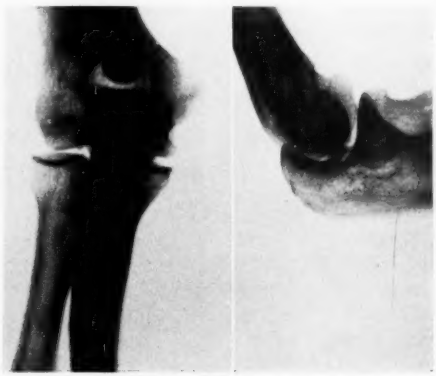

FIG. 10

Right elbow of a man aged twenty-seven. A large loose body in the olecranon fossa is of the type said to arise from the supratrochlear septum. Note the pit in the capitellum from which the loose body has come.

FIG. 11

A late case of osteochondritis dissecans. Comparison of the affected and the normal elbow shows the enlargement of the head of the radius, irregular flattening of the capitellum, and loose body formation. Further loose bodies were seen in the lateral view, and twelve were removed at operation.

It should be mentioned before concluding the account of the radiographic changes that they must not be confused with those of the entirely different and rare condition of multiple epiphysial dysplasia. In this there may be distortion in shape of the radio-humeral articulation but the changes are not superimposed on a previously normal elbow.

## ASSOCIATED CHANGES

**Enlargement of the head of the radius**—The head of the radius was unmistakably enlarged in 50 per cent of the cases we studied. Löhr (1930) goes so far as to say that all cases exhibit this enlargement, but it should not be recorded too readily, because apparent enlargement has often been disproved on actual measured comparison with the normal side. The enlargement is characteristically postero-lateral, and, if the radial epiphysis has not fused, the metaphysis is often of an accentuated funnel shape (Fig. 13). The enlargement may occur before or after closure of the epiphysis. The degree of enlargement has not been shown to be proportional to the altered contour of the capitellum. It is unlikely to be related to disturbance at the epiphysial plate, as suggested by Löhr, because growth here is entirely longitudinal and the epiphysis itself grows by circumferential accretion. It is possible that laxity of the capsule, by removing a restraining influence, may lead to enlargement of the head of the radius. We have found that enlargement of the head of the radius may occur from causes other than osteochondritis dissecans, for example after T-shaped fractures and subluxations of the head. It would appear that at least some of the enlargement occurs at the expense of the overlying cartilage, which becomes thin and purple in colour but is smooth and regular, without the marginal " cuffing " found in osteoarthritis. In long-standing cases the regularity may be lost and the head assume the most grotesque deformity (Fig. 14).
**Epiphysial prematurity**—Löhr has studied at some length the epiphysial changes associated with osteochondritis dissecans of the elbow. He believes that there is a premature fusion of the lower humeral and upper radial epiphyses; further, that in contrast with the usual sequence, fusion always begins on the lateral aspect and proceeds medially, and that these changes occur after the first sign of osteochondritis dissecans in the capitellum. It is well known that injury to the elbow accelerates the appearance and development of the ossific nuclei, as substantiated by Bauman, but Löhr is careful to distinguish this from premature fusion of the epiphysis which, he says, does not occur after any injury other than crushing of the cartilage plate. The growth stimulation of injury may act over a period of many years and cause a considerable enlargement of the bone ends involved, but the pattern of fusion is not disturbed. In osteochondritis dissecans, the local growth stimulus acts only over a brief period near puberty, and causes no great enlargement.

We have studied the development and fusion of the elbow epiphyses in normal children between the ages of nine and fifteen, and like other observers have found a considerable individual variation in the age at which the ossific nuclei appear and at which the epiphysial lines fuse; but, although there is often a discrepancy between the maturity of the ossific centres on either side, there is rarely any difference in the time of epiphysial closure. In our experience fusion of the lower humeral epiphyses is found to be well advanced in most children at fifteen years; the opportunities of confirming the disturbances of epiphysial behaviour are therefore limited, because of the age at which most of these patients first attend. Only three cases in our series showed this premature epiphysial closure, and it is interesting that one case showed a marked difference in epiphysial maturity of the elbows with a little enlargement of the head of the radius on the more mature side, but no other abnormality when first seen (Fig. 13). Five years later the more mature elbow showed gross destruction of the head of the radius with irregular cyst-like changes in the capitellum, which, however, had not progressed to the formation of loose bodies (Fig. 15). Figure 7 also illustrates a case of premature epiphysial fusion.

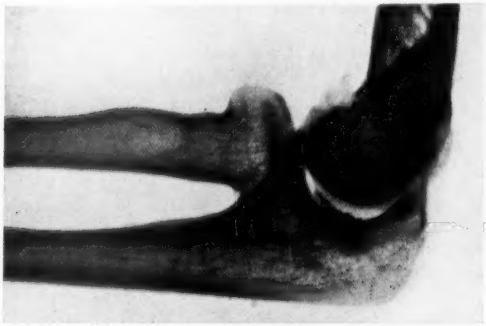

FIG. 12

Lateral view of the same case as Figure 5 to demonstrate distortion of the upper end of the ulna, in addition to changes in the capitellum and head of radius. This feature is observed only in severe cases.

FIG. 13

The affected and the normal elbow in a boy aged fourteen years. The enlargement of the head of the radius is well shown; there is marked prematurity of the epiphyses at the lower end of the humerus.

FIG. 14

A late case demonstrating the grotesque distortion of the head of the radius which may sometimes occur.

FIG. 15

The same case as Figure 13, five years later, with irregular cyst-like change in the capitellum. No actual loose body has yet been found.

**Multiple joint incidence**—Bilateral involvement of the elbow has already been mentioned. It also occurs in the knee, with symmetrical involvement of the patellae or femoral condyles (Blanco 1921, Wagoner and Cohn 1931, Bernstein 1925). Watson-Jones (1943) quotes a case in which osteochondritis dissecans was present in both elbows and both knees, and Walter (1926) describes a case involving both knees and one elbow. Mr Geoffrey Hyman and Mr Robert Roaf have kindly allowed us to publish particulars of two similar cases in which multiple joints were involved.

**Case 1**—Mr Hyman's case. A boy aged eighteen years complained that for a few weeks he had noticed an aching pain in the left hip after vigorous exercise. Radiographs showed distortion of each femoral head with symmetrical separation of single loose bodies (Fig. 16). It was later discovered that he had had spontaneous locking of the left elbow five months previously, and radiographs revealed bilateral and typical osteochondritis dissecans of the capitellum, with loose bodies and enlargement of the head of each radius (Fig. 17).

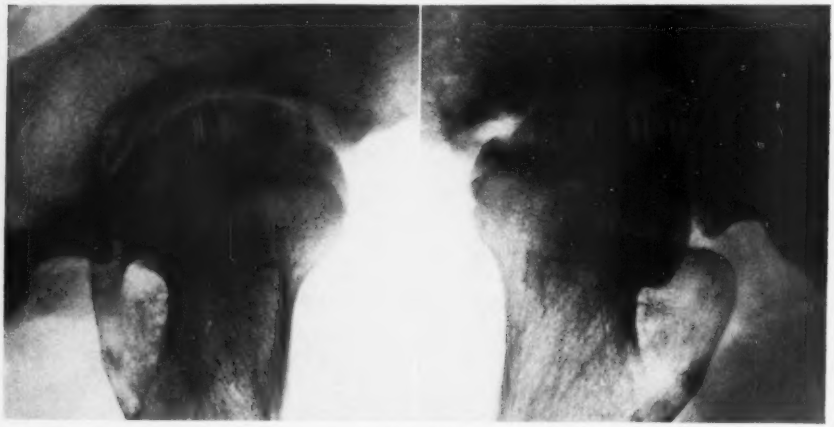

FIG. 16

FIG. 17

**Case 1.** Figure 16—Lateral views of both hips in a boy aged eighteen years, with symmetrical osteochondritis dissecans of the head of each femur. Figure 17 shows osteochondritis dissecans of the right elbow with loose body formation. Similar changes were present in the left elbow.

**Case 2**—Mr Roaf's case. A girl aged eleven years, with general dwarfism of obscure origin, complained of pain and limited extension of the right elbow six days after an injury. The head of the radius was palpably enlarged and extension of the elbow was limited. Radiographs of the skeleton revealed bilateral osteochondritis dissecans of the patellae and medial femoral condyles with similar changes in both elbows (Figs. 18 and 19).

The significance of multiple joint involvement was not appreciated until late in our investigation, and a more complete radiological examination might well have revealed other lesions.

**Hereditary factor**—No hereditary or familial factor was recorded in any of our own cases. Wagoner and Cohn (1931) described osteochondritis dissecans of the knee in a father, son and paternal uncle; and bilaterally in two brothers, although the evidence in one knee was doubtful. Bernstein (1925) described bilateral affection of the knee in two sisters and their brother.

FIG. 18

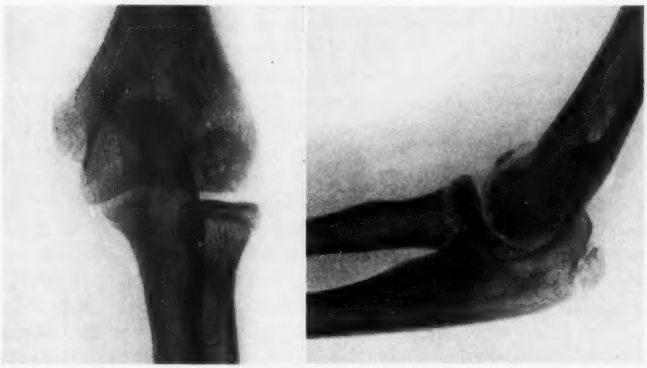

FIG. 19

**Case 2**—Multiple osteochondritis dissecans in a girl aged eleven years with dwarfism. Each knee had two lesions, one of the inner femoral condyle, and the other of the patella; there were also changes in both elbows.

## OPERATIVE FINDINGS

The operative findings vary according to the type of lesion, but the usual appearance is that of an untidy and ragged change involving a large area of the capitellum. There is frequently a hinged flap of articular cartilage overlying a fairly deep crater in the bone. Multiple loose bodies are commonly found. Some of these may have been revealed in the radiograph before operation because they contained a fragment of bone, or have become calcified, but the smaller ones consist of articular cartilage only, and, if they have been free in the joint for any length of time, become rounded in shape. Only one patient with a lesion in the head of the radius underwent operation; the irregularity of the convex margin was noted before excision of the head, but there was no actual break in the articular surface.

In the later cases loose bodies may be removed from some other part of the joint without exposure of the primary lesion; if the capitellum and head of the radius are seen, they are found to be irregular and roughened with the beginning of secondary degenerative change. Sometimes the indication for operation in these cases is excision of the radial head, to improve radio-ulnar movement, rather than removal of a loose body.

## TREATMENT

A review of the literature indicates that the general opinion is against early operative intervention. The fate of an incompletely detached fragment of articular cartilage or a hinged loose body cannot be forecast, and when the elbow is exposed at operation in an early case there is a great temptation to remove partly detached fragments as well as the loose bodies. If these fragments were left in place, it is possible that they might survive and help to reconstitute a better articular surface for the capitellum. In the knee it is known that conservative treatment with splintage of the joint for a lengthy period may encourage the reattachment of a potential loose body (Dwyer 1950). In the elbow there is a danger that long-continued immobilisation may cause stiffness. In the early cases, therefore, the middle course appears to be best: the elbow should be rested in a sling, but allowed some freedom for movement; operation should not be undertaken.

At a later stage the indication for surgery becomes more definite. The loose bodies have become detached and there are good reasons for their removal. Operation will not necessarily involve any exploration or surgical attention to the primary site of detachment. The incision or incisions will be planned without regard to any exploration of the capitellum or head of radius, and will be made for the loose bodies themselves. The only further indication for surgical treatment is that, if the head of the radius is much enlarged and there is roughening and degenerative change between the head of the radius and capitellum, excision of the head of the radius may be called for to improve radio-ulnar movement. This indication is not likely to arise in the more severe cases with general distortion of the shape of the joint; some permanent disability is likely to remain whatever is done surgically for such patients.

## DISCUSSION

The main etiological theories of osteochondritis dissecans are too well known to justify repetition here; they have been enumerated with faithful constancy and in great detail in most published works on the subject. The cause of osteochondritis dissecans is not known. It may even be that its cause is to be found in more than one condition, but the theory which takes cognisance of the greatest number of established facts will convince us most. Among such facts demanding explanation we would include particularly: 1) the history of mild injury in nearly half the cases; 2) the overwhelming preponderance of males; 3) the tendency for multiple loose bodies to be formed—not all at the same time; 4) the radiological picture of patchy rarefaction followed by cyst-like change underlying separated fragments; 5) the

limitation to convex articular surfaces—head of femur, capitellum, convex borders of head of radius and talus; 6) the onset in adolescence; 7) the multiple joint involvement, including bilateral cases; 8) the association with epiphysial prematurity; and 9) the predilection for the right side in the case of the elbow.

The role of injury is admittedly difficult to assess. Osteochondral fractures undoubtedly lead to loose bodies but, being intra-articular, these are injuries severe enough to produce effusion, and are likely to be remembered. Such was not suggested by the histories in our cases. Attention has been drawn to the effect of repeated minor injury, for example, the " baseball elbow " (Bennett 1941), but we are not at all convinced that this is in any way related to osteochondritis dissecans of the elbow. In this connection it is worthy of note that of 828 pneumatic-drill workers suffering from an occupational disability of the elbow joint only seven had osteochondritis dissecans (Rostock 1933). A history of injury can be obtained in most cases of tuberculosis of the limb joints, but none would deprive the tubercle bacillus of the major role; it is our belief that the place of injury in osteochondritis dissecans of the elbow is secondary, rather than primary as suggested by Fairbank (1933).

The evidence for a general or constitutional factor is much stronger. The patients are at an age when hormonic balance is precariously set, when epiphyses mature and fuse, and when they are prone to vascular and mechanical disturbances. Silberberg and Silberberg (1946) have demonstrated experimentally the effect of androgens on epiphysial maturity in male and female mice; Harris (1950) has shown the effect of testosterone on the strength of the epiphysial junction; and Schaefer *et al.* (1939) have emphasized the high incidence of epiphysial disturbances in endocrinopathic patients. The role of the endocrines in the normal control of bone and cartilage growth presents a complex and somewhat confusing picture. Nevertheless we think it likely that the explanation of the male preponderance, the epiphysial prematurity and the multiple joint involvement in this condition will be found in a better understanding of the hormonal and constitutional influences on skeletal growth.

It is interesting to compare the male sex preponderance with that of Perthes' disease of the hip (75 per cent, Brailsford 1948). In this condition, too, circumscribed osteocartilaginous areas may become sequestrated as described by Mroz (1932) and we ourselves have records of three such cases, the picture being indistinguishable from osteochondritis dissecans. In this connection, attention may be drawn to osteochondritis juvenilis of the capitellum, a condition usually discovered accidentally, and with the greatest incidence at about eight years of age. Of the ten recorded cases in the literature, nine were in boys—one of whom had an associated Perthes' disease of the hip. (We have encountered two such cases with involvement of both hip and elbow in the last year.) The few cases which have been followed up over a period of years have shown complete restitution of the capitellum with symptomless and clinically normal elbows. It is conceivable that some cases of osteochondritis juvenilis of the capitellum do not progress to complete restitution, and that, as in the case of its counterpart in the hip, a localised osteocartilaginous portion becomes sequestrated; one recalls that when loose bodies follow Perthes' disease of the hip, symptoms are not usually manifest before adolescence.

In considering the local changes we would confirm our belief in the view originally expressed by Wolbach and Alison (1928), and later stressed by Ghormley (1932) and Conway (1937), that an alteration in the architecture of the bone with cyst-like formation in the presence of intact overlying cartilage precedes the formation of loose bodies.

In conclusion, we believe that evidence of a constitutional factor is strong, but that the predilection for certain joints, for the right elbow, and for convex articular surfaces, can only be explained on the basis of a local factor. Thus we are tempted to support a concept of two main factors: an overriding constitutional factor which determines the onset of the condition, and one or more local factors which determine the particular anatomical site of the lesion. In rare cases the constitutional factor is so marked that almost any convex articular surface

may be affected, but in most cases one must assume that the factors are more finely balanced, with consequent affection of one or two joints only.

We wish to acknowledge very generous help from many sources during the last two or three years. Our colleagues in Liverpool and elsewhere have kindly made available to us records and radiographs of interesting cases, and we have also received much valuable assistance in the translation of articles. Nurses and radiographers have responded nobly to the extra calls upon their time involved in the survey and other investigations. We should especially like to record our indebtedness to Sir Thomas Fairbank, Mr F. C. Dwyer, Mr G. Hyman, Mr B. L. McFarland, Mr R. Roaf, Mr H. J. Seddon and Mr Goronwy Thomas.

REFERENCES

BAUMAN (1930): quoted by Löhr, W.
BENNETT, G. E. (1941): Journal of the American Medical Association, **117,** 510.
BERNSTEIN, M. A. (1925): Journal of Bone and Joint Surgery, **7,** 319.
BLANCO, PIO (1921): Journal of Orthopedic Surgery, **3,** 104.
BRAILSFORD, J. F. (1948): The Radiology of Bones and Joints. Fourth edition. London: J. & A. Churchill Ltd., 265.
BURROWS, H. JACKSON (1949): Nottingham Meeting, British Orthopaedic Association. Journal of Bone and Joint Surgery, **31–B,** 478.
CASTAY, F. (1936): Bulletins de la Société de Radiologie, **24,** 465.
CHRISTENSEN, L. O. (1930): Egeskrift for Laeger, **92,** 716.
CONWAY, F. M. (1937): American Journal of Surgery, **N.S. 38,** 691.
DWYER, F. C. (1950): Personal communication.
FAIRBANK, H. A. T. (1933): British Journal of Surgery, **21,** 67.
GHORMLEY, R. (1932): Proceedings of the Staff Meetings of the Mayo Clinic, **7,** 42.
HARRIS, W. ROBERT (1950): Journal of Bone and Joint Surgery, **32–B,** 5.
JONES, R., and LOVETT, R. W. (1929): Orthopaedic Surgery. Second edition. London: Humphrey Milford, Oxford University Press.
KAPPIS, M. (1920): Deutsche Zeitschrift für Chirurgie, **157,** 187.
KING, DON (1932): Journal of Bone and Joint Surgery, **14,** 535.
KING, DON, and RICHARDS, V. (1940): Journal of Bone and Joint Surgery, **22,** 327.
LITTLEJOHN, C. W. B. (1933): Australian and New Zealand Journal of Surgery, **2,** 278.
LÖHR, W. (1929): Archiv für klinische Chirurgie, **157,** 752.
LÖHR, W. (1930): Archiv für klinische Chirurgie, **162,** 489.
MEYER-WILDISEN, R. (1932): Schweizerische Medizinische Wochenschrift, **13,** 579.
MILLER, L. F. (1936): Radiology, **27,** 237.
MORTON, H. S., and CRYSLER, W. E. (1945): Journal of Bone and Joint Surgery, **27,** 12.
MROZ, R. J. (1932): Proceedings of the Staff Meetings of the Mayo Clinic, **7,** 41.
MURPHY, F. G. (1936): Proceedings of the Institute of Medicine, Chicago, **11,** 193.
NIELSEN, A. (1931): Hospitalstidende, **74,** 701.
ROSS, W. T. (1947): Journal of Bone and Joint Surgery, **29,** 514.
ROSTOCK, P. (1933): Archiv für Orthopädische und Unfall-Chirurgie, **33,** 449.
SCHAEFER, R. L., STRICKROOT, F. L., and PURCELL, F. H. (1939): Journal of the American Medical Association, **112,** 1917.
SCHIRMER, A. (1925): Schweizerische Medizinische Wochenschrift, **6,** 489.
SILBERBERG, M., and SILBERBERG, R. (1946): Anatomical Record, **95,** 97.
STAA, H. VON (1930): Archiv für klinische Chirurgie, **161,** 281.
TEMPSKY, A. VON (1930): quoted by Löhr, W.
WAGONER, G., and COHN, B. N. E. (1931): Archives of Surgery, **23,** 1.
WALTER, VERHANDL (1926): Med. Naturwiss Gess in Munster Sitzg.
WATSON-JONES, R. (1943): Fractures and Joint Injuries. Third edition. Edinburgh: E. & S. Livingstone Ltd., p. 87.
WILLIAMS, E. ROHAN (1939): Text-book of X-ray Diagnosis by British Authors (Editors, S. Cochrane Shanks and P. Kerley). London: H. K. Lewis & Co. Ltd., p. 490.
WOLBACH, S. B., and ALISON, N. (1928): Archives of Surgery, **16,** 1176.

# TWO CASES OF OSTEOCHONDRITIS DISSECANS AFFECTING SEVERAL JOINTS

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Osteochondritis dissecans affecting a single joint has been widely studied since the term was first introduced by König in 1887. Multiple lesions are comparatively uncommon; those most often reported are lesions of both medial femoral condyles (Hermanson 1946, King 1932). Other combinations reported are: the medial femoral condyle and opposite patella (Archer and Peterson 1930); both patellae (*ibid.*); both knees and both elbows (Watson-Jones 1943); and both knees and one elbow (King 1935, quoting Walter). It is here proposed to describe two cases of multiple lesions, and to examine in the light of these cases some of the hypotheses of etiology.

## CASE REPORTS

**Case 1**—(Figs. 1 to 6.) A gardener, aged eighteen years, gave a history of seven months' pain in the left buttock, experienced on walking. The left knee was sometimes swollen. For four years he had been unable to extend either of his elbows fully, and the left one ached at times. He could remember no severe injury, but was a keen player of football and cricket and had been one of the best athletes at his school. There was no record of any joint trouble in other members of his family.

*Examination*—The patient was short and wiry, and showed no evidence of endocrine disorder. In each elbow there were ten degrees of limitation of flexion, extension and supination; rotation caused crepitus over the radial head. In the left hip there was slight limitation of abduction and medial rotation. An effusion was present in the left knee with pain on full flexion. The other joints were clinically normal.

*Radiographs* revealed osteochondritis dissecans of each patella. In each elbow the capitellum showed an area of osteoporosis and the radial heads showed some irregularity suggesting osteochondritis dissecans, but much less than was disclosed at operation. Control radiographs of the hands revealed no osteoporosis.

*Biochemistry and haematology*—Blood count, normal; serum calcium, 10·9 milligrammes per cent; inorganic phosphorus, 4·6 milligrammes per cent; serum alkaline phosphatase, 11·4 King-Armstrong units; serum acid phosphatase, 2·4 King-Armstrong units; blood urea, 21 milligrammes per cent; urinary calcium, 250 milligrammes in twenty-four hours; urea clearance, 96·5 per cent of average function; faecal fat, normal; Wassermann reaction, negative.

*Operations*—Left elbow: A loose body was removed from between the humerus and the radius; it corresponded closely with the shape of an eroded area on the outer side of the radial head, which was excised. Right elbow: Two loose bodies were removed from in front of the lower end of the humerus. The cartilage of the capitellum was softened centrally and that of the radial head showed similar but more pronounced changes. It seemed likely that the loose bodies had originated from these lesions. Right knee: The medial articular surface of the patella was grossly degenerated, the cartilage being heaped up and softened in parts, and eroded elsewhere. The patella was excised. The femoral surfaces were intact and no loose body was found. Left knee: An eroded area on the postero-medial aspect of the patella extending centrally into the bone was curetted and the edges were bevelled. The femoral surfaces were intact and no loose body was found.

*Follow-up*—Six months after the last operation the knees had fully recovered but both

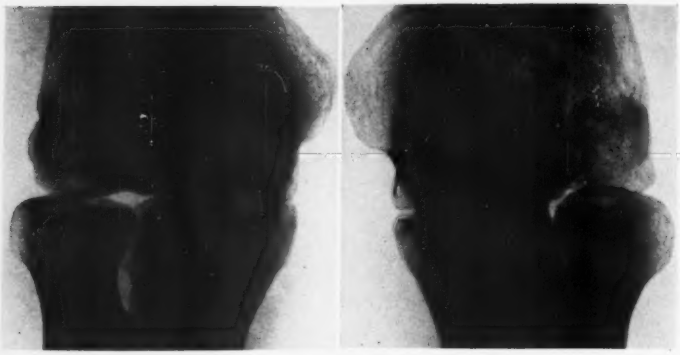

FIG. 1

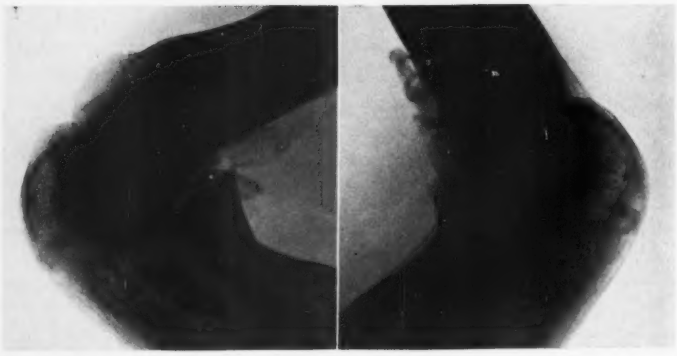

FIG. 2

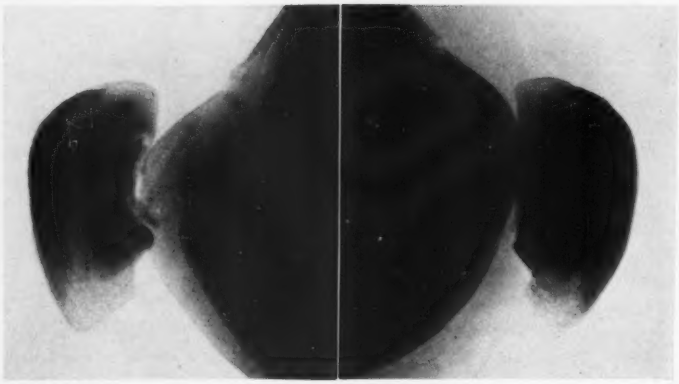

FIG. 3

**Case 1**—Radiographs of elbows and patellae showing lesions of the articular surfaces and loose bodies in the elbow joints.

FIG. 4

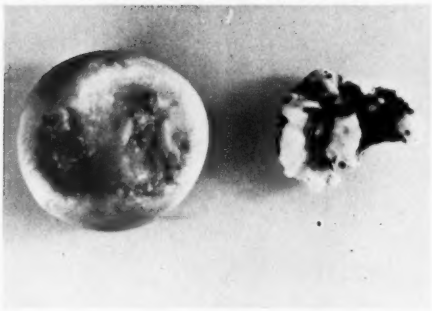

FIG. 5

FIG. 6

**Case 1**—Left radial head at operation (Fig. 4) and after excision, with the loose body found in the joint (Fig. 5). The right patella, showing the erosion and heaped-up cartilage (Fig. 6).

elbows showed thirty degrees of limitation of extension. Other movements were normal and the patient was free from pain.

*Pathological report* (Dr H. A. Sissons): 1. The eroded area of the head of the left radius showed a grossly abnormal extension into the underlying tissue of partly necrotic, partly calcified cartilage. 2. The loose bodies from the right elbow joint consisted partly of bone and partly of cartilage. Having been entirely detached from the synovial surface, one of them had no vasculature. 3. The lesion of the right patella presented the characteristic changes of osteochondritis dissecans. A large area of articular cartilage was separated and a slab radiograph showed extensive degenerative calcification in its deep part. Although separated, most of the cartilage was still living.

The histology of the specimens was essentially the same as that previously reported in the literature and provided no fresh evidence about the origin of the loose bodies or the nature of the process whereby they become separated.

**Case 2**—(Figs. 7 to 14.) A schoolboy, aged fifteen years, had pain in both elbows for a year, noticed especially when boxing; there was limitation of flexion and extension. Recently the left knee had been slightly painful after a football "strain." No other member of his family had any joint trouble.

*Examination*—Both elbows showed thirty degrees of limitation of flexion and extension, slight limitation of supination, and marked crepitus over the radial heads on rotation. The left knee was painful on full flexion. No other abnormality was found.

*Radiographs* revealed osteochondritis dissecans of each capitellum, with a loose body present on the right side. An ill-defined area of osteochondritis dissecans was present in the right medial femoral condyle. The other joints were normal.

*Biochemistry and haematology*—Blood count, normal; serum calcium, 9·7 milligrammes per cent; inorganic phosphorus, 4·9 milligrammes per cent; serum alkaline phosphatase, 8·6 King-Armstrong units; serum acid phosphatase, 3·8 King-Armstrong units; blood urea, 57 milligrammes per cent; urinary calcium, 105 milligrammes in twenty-four hours; faecal fat, normal; Wassermann reaction, negative.

*Operation*—(Figs. 11 to 14.) From each elbow joint several loose bodies were removed and a large fragment of the capitellum lying almost loose was excised. The margin of the head of the radius in each elbow was eroded. The knee joint was not explored.

*Pathological report* (Dr H. A. Sissons)—The loose bodies consisted of cartilage, but bone was present in the larger attached specimens. In the smaller specimen the superficial cartilage was living and still growing but extensive necrosis of the deep tissue was present.

## DISCUSSION

The individual lesions in these cases did not differ in appearance from many already reported and their interest lies in the bilateral and multiple distribution. The etiological factors which have to be considered are injury, developmental anomaly and constitutional disturbance.

Though a history of severe injury was lacking in both cases, it is clear that young athletic males meet with frequent minor injuries, affecting especially such exposed joints as the elbows and the knees. The similarity of the lesions on each side is, however, so striking that one cannot but agree with Bernstein (1925), Wagoner and Cohn (1931), Harbin and Zollinger (1930) in looking for some factor other than injury alone. In lesions of the medial femoral condyles a congenital anomaly within the joint, such as an unusually long tibial tubercle, has been suggested by Fairbank (1933). No mechanical cause of this kind was apparent in these cases. There was no evidence of congenital anomaly of the cartilage such as Kappis (1920) suggested might make it more liable to injury; the problem seems to be one of bone rather than of cartilage. Reiger (1920) spoke somewhat vaguely of a "predisposition," a

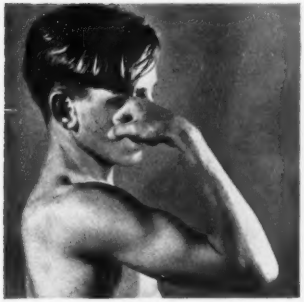

FIG. 7

FIG. 8

**Case 2**—A boy aged fifteen years—Photographs showing the pre-operative range of movement of the right elbow. The range of the left elbow was exactly similar.

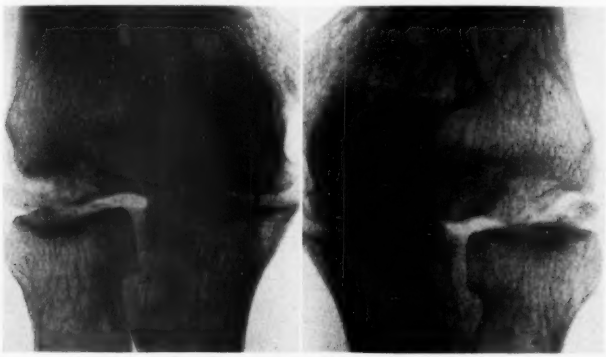

FIG. 9

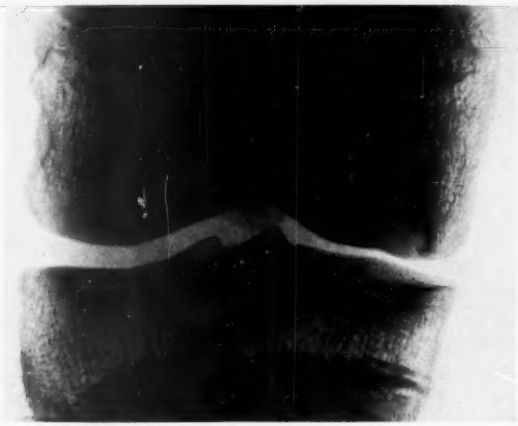

FIG. 10

**Case 2**—Figure 9—Radiographs of the elbows showing typical changes in each capitellum and complete epiphysial fusion. Figure 10—Radiograph of the right knee, showing an extensive area of early osteochondritis of the medial femoral condyle.

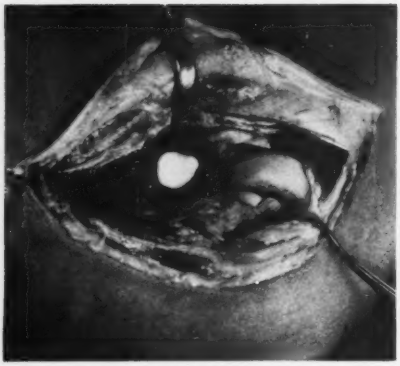

FIG. 11

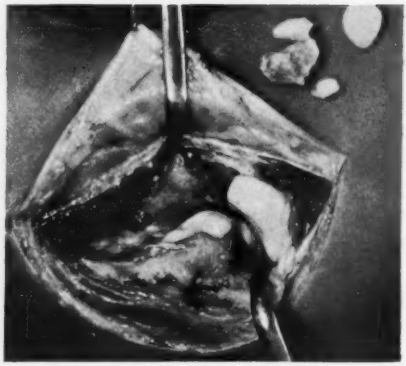

FIG. 12

**Case 2**—The right elbow joint at operation. Figure 11—A loose body is seen in the front of the joint. The narrow retractor points to the affected segment of the capitellum. Figure 12—The residual defect in the capitellum is well shown; deeper again is another loose body.

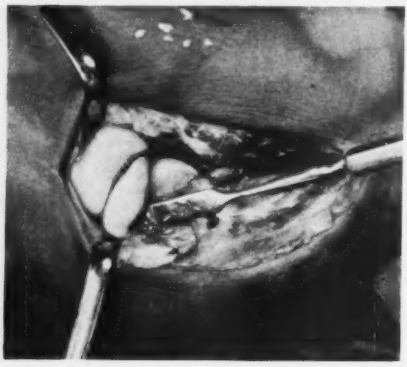

FIG. 13

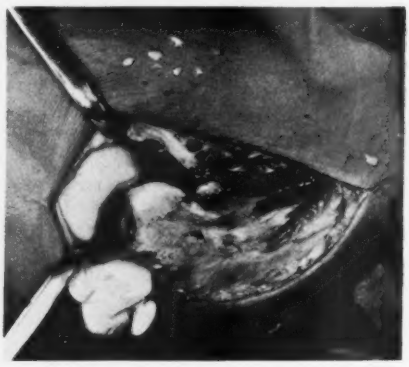

FIG. 14

**Case 2**—The left elbow joint at operation. Figure 13—Numerous flakes of cartilage floating in the synovial fluid have been removed. A large segment of capitellum, almost completely separated, can be seen. Figure 14—The segment having been levered out is seen to be attached only by some strands of periosteum.

constitutional disturbance. Such an idea seems to gain support from the occurrence of multiple lesions in more than one member of a family, as in Wagoner and Cohn's three cases—a boy, his father and his uncle—each with bilateral osteochondritis of the knee arising between the ages of twelve and fifteen, and proved radiographically or by operation. There was no family history of similar affection in these cases, nor clinical evidence of endocrine or other constitutional disturbances; no pathological evidence of disturbed calcium or phosphorus metabolism was found, but balance investigations were not done.

## SUMMARY

1. Two cases of osteochondritis dissecans affecting several joints are described.
2. There is no evidence that injury, congenital anomaly or constitutional disturbance played any part in the etiology of either case.

The writer wishes to thank Mr H. Jackson Burrows for his assistance in the preparation of this report, Mr K. I. Nissen for the records of the second patient, Dr H. A. Sissons for his pathological reports, and Mr R. J. Whitley for the photographic work.

## REFERENCES

ARCHER, V. W., and PETERSON, C. H. (1930): Osteochondritis dissecans. Southern Medical Journal, **23,** 611.
BERNSTEIN, M. A. (1925): Osteochondritis dissecans. Journal of Bone and Joint Surgery, **7,** 319.
FAIRBANK, H. A. T. (1933): Osteochondritis dissecans. British Journal of Surgery, **21,** 67.
HARBIN, M., and ZOLLINGER, R. (1930): Osteochondritis of the growth centres. Surgery, Gynecology and Obstetrics, **51,** 145.
HERMANSON, R. H. (1946): Bilateral osteochondritis dissecans of the knee. Radiology, **47,** 349.
KAPPIS, M. (1920): Über Bau, Wachstum und Ursprung der Gelenkmäuse. Deutsche Zeitschrift für Chirurgie, **157,** 214.
KING, D. (1932): Osteochondritis dissecans: A clinical study of twenty-four cases. Journal of Bone and Joint Surgery, **14,** 535.
KING, E. S. J. (1935): Localised rarefying conditions of bone. London: Edward Arnold and Company.
KÖNIG, F. (1887):Ueber freie Körper in den Gelenken. Deutsche Zeitschrift für Chirurgie, **27,** 90.
RIEGER, H. (1920): Zur Pathogenese von Gelenkmäusen. Münchener Medizinische Wochenschrift, **67,** 719.
WAGONER, G., and COHN, B. N. E. (1931): Osteochondritis dissecans: A résumé of the theories of etiology and the consideration of heredity as an etiologic factor. Archives of Surgery, **23,** 1.
WATSON-JONES, R. (1943): Fractures and joint injuries. Third edition. Edinburgh: E. & S. Livingstone Ltd.

# OSTEOID OSTEOMA WITH UNUSUAL SYMPTOMS

## Case Report

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*From the Orthopaedic Department, St Bartholomew's Hospital, Rochester, Kent*

Osteoid osteoma has come to be associated with a typical clinical history. There is gradual, unexplained onset of pain, which is described as "boring" and "aching," and occurs especially at night; it is relieved by aspirin, though often by nothing else. In most of the recorded cases the pain has been closely referred to the site of the osteoid osteoma. The case presented here is of interest in that the distribution of the pain was misleading, and suggests that in cases in which the pain is typical, but the radiographs show no abnormality in the area complained of, a wider radiological search for the lesion may be advisable.

FIG. 1

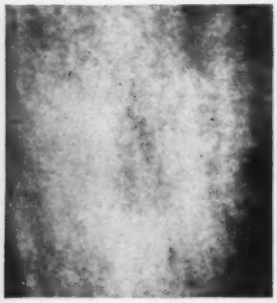

FIG. 2

Figures 1 and 3—Radiographs of the lesion; Figure 2—An enlargement of the central area. Note the "sequestrum" within the translucent zone.

FIG. 3

R. V. H., aged twenty-two years, a travelling salesman, first attended St Bartholomew's Hospital, Rochester, in January 1949. He stated that two and a half years previously, while serving in the Army in the Middle East, he began to feel pain deep in the substance of the right thigh; very occasionally the pain spread into the right knee. From that time onwards he was never free from pain. He described its character as very wearing and boring, like toothache. He found that it was always relieved by aspirin, which he took regularly many times a day. The pain woke him at night about 2 a.m. and 5 a.m. There were no other symptoms. Soon after the onset of the pain he had been investigated by Army medical officers who failed to find any organic disease. He was seen by several psychiatrists who were in agreement that he was of a mentally immature and slightly unstable type. It was concluded that the pain was functional in origin, and he was ultimately invalided from the Army on those grounds.

*On examination*, there were no abnormal physical signs except slight wasting of the right

thigh. Radiographs of the hip and femur showed no abnormality. The patient appeared rather anxious and nervous, and did not make a very favourable impression except in being a good and consistent witness. For this reason the case was several times thoroughly reviewed. Eventually, because of the complaint of occasional pain in the knee, the joint was radiographed. No abnormality was seen in the knee itself, but in one film there appeared to be a little density in the centre of the shaft of the tibia. A further radiograph, centred on this area, was made. It showed a well-marked area of sclerosis in the posterior part of the upper end of the shaft of the tibia (Figs. 1 and 3). In the centre of this area there was an ill-defined lesion which had the appearance of a small oval cavity with a doubtful small sequestrum at its centre (Fig. 2). The radiographs suggested a chronic abscess of the tibia, but in view of the nocturnal pain the diagnosis of osteoid osteoma was regarded as a distinct possibility, and the patient was advised to submit to a biopsy of this abnormal area. Operation was undertaken through a posterior approach reflecting the popliteus. The raised irregular sclerosed bone on the posterior face of the tibia was removed with a gouge and the plane of cleavage fortunately passed through the centre of the lesion. It was revealed as a small purplish oval mass of what appeared to be cancellous bone, one centimetre in length, lying in pale sclerosed bone. The mass had adhered to the fragment removed, and left behind it in the tibia a perfectly smooth oval bed. There was no pus or granulation tissue, and nothing to suggest an inflammatory lesion. The wound was closed.

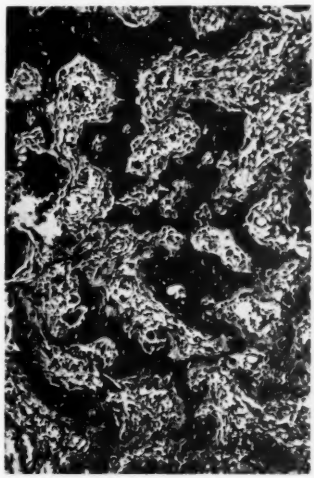

FIG. 4

Photomicrograph of the tumour, showing deeply stained trabeculae of osseous tissue covered by deep osteoid seams (×45).

The operation gave immediate relief from pain, and the patient was free from symptoms ten months later. The report on the pathological section was "osteoid osteoma from tibia" (Fig. 4).

I wish to express my thanks to Professor Dorothy Russell for the pathological examination of the specimen and for the photomicrograph.

# RUPTURE OF THE EXTENSOR POLLICIS LONGUS TENDON AFTER COLLES FRACTURE*

DAVID TREVOR, LONDON, ENGLAND

Subcutaneous rupture of the extensor pollicis longus tendon was first reported by Duplay in 1876. His patient, a woman aged thirty-six years, had fallen and injured her hand, without, so far as could be ascertained, sustaining a fracture. Kleinschmidt reviewed the literature in 1929 and found twenty-five examples of the rupture as a late complication of Colles fracture; McMaster, reporting a case in 1932, found twenty-seven others in the literature. Moore in 1936 recorded three examples, but by 1940 Kwedor and Mitchell were able to trace seventy cases and added a further one. Smith added five more in 1946.

This paper records the personal experience of nine patients with rupture of the tendon after fracture of the lower end of the radius.

## CLINICAL FEATURES

The clinical features did not differ materially from those previously recorded in the literature (see Table I). In all nine patients the posterior aspect of the lower end of the radius was involved by the fracture, the displacement being minimal in four, but sufficient to warrant reduction in five. All the patients were women: it is notable that the sex distribution recorded in the literature is 60 per cent female and 40 per cent male. Six patients were over fifty years of age; the youngest was twenty-three and the oldest sixty-four. McMaster (1932) stated that although the condition can occur at any age and has been recorded at fourteen years, it is more common after the age of thirty. The interval between the fracture and the tendon rupture varied from four weeks to one year, with an average of eleven weeks. Suture was undertaken from one week to five months after the rupture. Only three patients had the prodromal symptoms of swelling over the radial side of the back of the wrist or of pain in this area radiating into the thumb. In several patients the tendon "snapped" suddenly

TABLE I

ANALYSIS OF NINE CASES OF SPONTANEOUS RUPTURE OF EXTENSOR POLLICIS LONGUS TENDON

| Case | Occupation | Age | Side | Reduction of fracture | Time after fracture (*weeks*) | Prodromal symptoms | Delay till suture (*weeks*) | Residual gap (*inches*) | Suture removed later | Follow-up (*years*) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Violinist | 63 | L | No | 8 | — | 20 | ½ | No | 5 |
| 2 | Housewife | 35 | R | Yes | 5 | Pain | 3 | ¼ | No | 4 |
| 3 | Housewife | 57 | R | No | 4 | — | 4 | ¼ | Yes | 3 |
| 4 | Housewife | 23 | L | Yes | 8 | — | 4 | ¾ | Yes | 3 |
| 5 | Housewife | 63 | L | No | 4 | — | 12 | ¼ | Yes | 2 |
| 6 | Housewife | 54 | L | Yes | 6 | — | 2 | ¼ | Yes | 2 |
| 7 | Manageress | 44 | L | No | 6 | Pain | 2 | ¼ | No | 2 |
| 8 | Typist | 34 | R | Yes | 52 | Swelling | 1 | ¼ | No | 1 |
| 9 | Clerk | 64 | R | Yes | 7 | — | 1 | — | No | 1 |

* Paper read at the 1949 Spring Meeting of the British Orthopaedic Association.

while they were doing a simple movement requiring no undue exertion of the thumb—for example, putting on a baby's napkin or brushing the hair. The typical clinical appearance is shown in Figure 1.

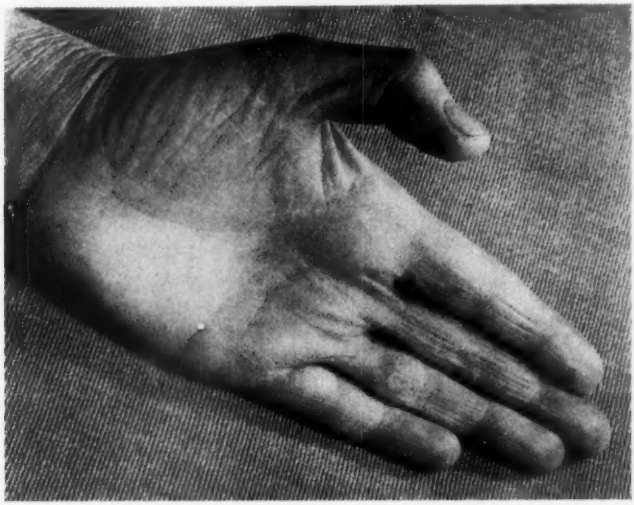

FIG. 1

Spontaneous rupture of the long extensor tendon. There is loss of extension at the interphalangeal joint and loss of full extension at the metacarpo-phalangeal joint.

## PATHOLOGY

A normal tendon is very strong; when subjected to excessive strain it will usually avulse bone or periosteum at its insertion, or rupture at the musculo-tendinous junction, rather than rupture in its own length. Spontaneous or pathological rupture occurs in tendons that are abnormal either because of disease such as tuberculous tenosynovitis, or of trauma, for example the repeated minor injuries of " drummer's palsy." The tendon that ruptures after a fracture of the lower end of the radius is likewise abnormal. Kleinschmidt (1929) considered that an incomplete tear was caused by a fragment of bone, but that in most cases this healed during the period that the wrist was immobilised; in the few cases in which healing was defective the tendon suddenly gave way at the weak area by sudden contraction of the muscle. But rupture of the tendon has often occurred in patients with so little disturbance of the bone surface that direct laceration of the tendon must have been improbable. Axhausen (1925) considered that friction over a sharp fragment of bone in the radial groove resulted in gradual fraying of the tendon. But the findings at operation do not support this hypothesis, for there is often no roughness of the groove and no fraying of the ruptured tendon ends. The most generally accepted theory is that suggested by Weigeldt (1914) and by Hauck (1923). They believed that tearing of the mesotendon at the time of the initial injury interferes with the blood supply to the tendon (it in any case decreases after the age of twenty-five) and so causes avascular necrosis; a sudden muscle contraction on the weakened tendon then causes the rupture. Operative findings lend support to this theory, for the tendon, particularly the proximal end, appears swollen, yellowish and bruised. Further, in a personal case one of the tendons of the extensor digitorum, although not ruptured, presented similar appearances even though it was well away from the fracture of the radius. In another case the ruptured tendon appeared to have been drawn out into a long, thin, smooth strip not unlike a

piece of stretched chewing gum, and suggesting that gradual softening and elongation had taken place. Microscopic section of the elongated tissue showed evidence of necrosis of the fibres with thrombosis of the capillary vessels within the tendon (Fig. 2).

FIG. 2
Section of a long, thin, smooth strip of tendon, showing evidence of necrosis of tendon fibres with thrombosis of the intra-tendonal capillary vessels. (× 125.)

## TREATMENT

The treatment of the condition is operative; conservative measures are useless. The double function of the extensor pollicis longus tendon is to extend the interphalangeal joint and more important, to elevate the thumb as a whole, as in grasping; to be successful, any reconstructive operation must restore both functions. In the past there have been isolated instances of direct suture of the tendon but in most cases tendon transplantation has been undertaken. 1) The distal end of the ruptured tendon has been inserted into the tendons of the extensor pollicis brevis and abductor pollicis longus. This restores active extension of the interphalangeal joint but fails to restore extension of the thumb as a whole. 2) The tendon of extensor carpi radialis longior has been transferred to the distal end of the ruptured tendon. Again there has often been inability to lift the thumb completely, because of the inadequate excursion of the transplanted tendon. 3) Transfer of the extensor indicis proprius has given satisfactory results regarding the thumb but at the cost of some permanent weakness of the index finger. 4) A free tendon graft has been used with varying success.

The author believes that the tendon can always be sutured with success, even after an interval as long as five months between rupture and suture. The operation is simple and the method has the advantage that the anatomy is restored almost to normal without interference with any other tendon.

**Technique of operation**—The distal end of the ruptured tendon is easily found just distal to the radius and is mobilised for a distance of one and a half inches. The groove previously occupied by the tendon is examined. Within it is found a thin strip of tissue which is preserved carefully and gently pulled upon; it leads the surgeon to the proximal end of the ruptured tendon which may have become adherent either to the radius well above the site of fracture, or to one of the tendons of extensor digitorum. The proximal end is mobilised up to the musculo-tendinous junction (Fig. 3). A suture of strong nylon (number 6) is threaded at each end on to a straight needle and is inserted into the proximal part of the tendon in a criss-cross manner, starting at least one inch from the ruptured end. The nylon suture crosses itself in the substance of the tendon and emerges on the ruptured surface. It is then passed into the substance of the distal stump of the tendon as a mattress suture emerging fully one inch beyond the point of rupture. The suture is drawn up firmly and tied under tension with the wrist joint and thumb in extension (Fig. 4). Only in one patient was it possible by this method to coapt the ruptured ends of the tendon; in the other eight cases there was a gap, usually about a quarter of an inch, despite the fact that the sutured tendon lay to the radial side of Lister's tubercle. In one patient the gap was as great as three-quarters of an inch, and in another half an inch.

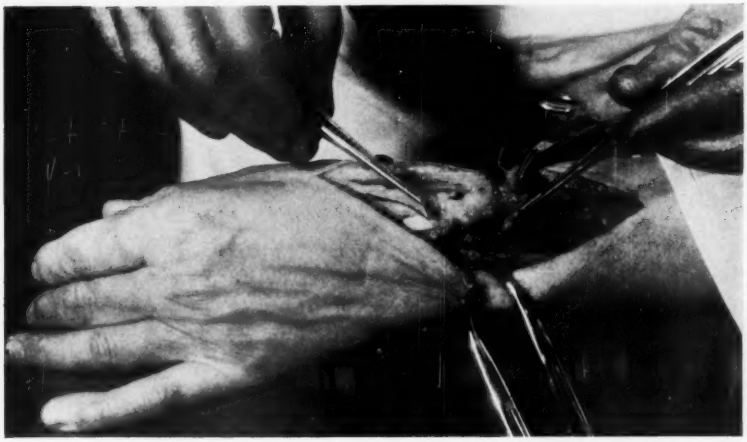

FIG. 3

Both ends of the tendon have been located and mobilised.

FIG. 4

The nylon suture has been inserted into the distal part of the tendon for a distance of 1 to 1½ inches and tied securely under tension with the thumb and wrist in dorsiflexion. Note the gap of a quarter of an inch between the tendon ends.

FIG. 5

FIG. 6

FIG. 7

Case 1. Suture of the long extensor tendon of the left thumb. The interval between rupture and suture was five months. The residual gap was half an inch. The photographs show the result four years later.

FIG. 8

FIG. 9

Case 4. Suture of long extensor tendon of left thumb. The residual gap at operation was three-quarters of an inch. The suture has been removed. The photographs show the result two years later.

After suture of the skin a lightly padded plaster is applied which allows a few degrees of flexion-extension movement of the interphalangeal joint, sufficient to prevent adhesions between the tendon and surrounding structures. Three weeks later the plaster is removed and active movements are begun. With persuasion full mobility of the thumb is gradually regained without resorting to special physical treatment.

The nylon suture may give rise to a sinus several weeks after operation; on four occasions the stitch was removed three months or more after operation. Removal of the suture was simple and on each occasion it was found that the gap had filled in with fibrous tissue similar in thickness to the tendon.

## RESULTS

In every case full function of the thumb has been regained. The first patient treated by the operation described has been observed for more than five years. Illustrative cases are shown in Figures 5 to 9.

## REFERENCES


AXHAUSEN, G. (1925): Beiträge zur Klinischen Chirurgie, **123,** 78.
DUPLAY, (1876): Bulletins et Mémoires de la Société de Chirurgie de Paris, **11,** 788.
HAUCK, G. (1923): Archiv für Klinische Chirurgie, **124,** 81.
KLEINSCHMIDT, K. (1929): Beiträge zur Klinischen Chirurgie, **146,** 530.
KWEDAR, A. T., and MITCHELL, C. L. (1940): Journal of Bone and Joint Surgery, **22,** 429.
MCMASTER, P. E. (1932): Journal of Bone and Joint Surgery, **14,** 93.
MOORE, T. (1936): British Journal of Surgery, **23,** 721.
SMITH, F. M. (1946): Journal of Bone and Joint Surgery, **28,** 49.
WEIGELDT, W. (1914): Beiträge zur Klinischen Chirurgie, **94,** 310.


## DISCUSSION BY MR R. J. FURLONG

*(Contributed after the original reading of the Paper)*

Mr Furlong said that he wished to comment only on the technique of operation and the results obtained. Like Mr Trevor, he had found end-to-end suture in continuity usually impossible in the type of case described. The use of a scaffolding of suture material to promote continuity by growth of fibrous tissue was ingenious; unless, however, there was meticulous end-to-end apposition of tendon, the suture line adhered firmly to surrounding tissue, even if this was paratenon and not fibrous sheath.

The excellent results shown in Table I had not yet been equalled by any other method. It was fortunate that even if adherence should occur—a tenodesis, in fact—apparent active extension of the terminal thumb joint could take place by flexion at the wrist. This action would bear most of the hall-marks of perfect function and would be satisfactory to the patient.

A parallel could be found in the chimpanzee. In this animal the *flexor* longus pollicis tendon is attached to the lower end of the radius, there being no specific muscle. Grasping is achieved by dorsiflexion of the wrist, thereby flexing the tip of the thumb against the fingers. This arrangement works well; the chimpanzee, though heavy, is arboreal. The thought that there is a comparable explanation for these excellent results must occur.

An alternative operation, favoured by some, has been to suture the extensor longus tendon to the extensor brevis where they lie close together over the metacarpal. By adjustment of tension, the insertion into the proximal phalanx was neutralised and the effective action of the brevis muscle was to extend the terminal phalanx. The new motor had not quite the desired excursion, but the system worked admirably, and was, of course, known to be the normal arrangement in some primates.

# DYSCHONDROPLASIA WITH HAEMANGIOMATA (MAFFUCCI'S SYNDROME)

## Report of a Case Complicated by Intracranial Chondrosarcoma

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The association of dyschondroplasia with haemangiomata is a rare condition first described by Maffucci in 1881. Of the two components of the syndrome, the dyschondroplasia is identical with Ollier's disease and the vascular abnormalities in the form of cavernous haemangiomata and phlebectasia appear to be coincidental. Carleton, Elkington, Greenfield and Robb-Smith (1942) reviewed eighteen cases from the literature and added two of their own, suggesting that the syndrome be named after Maffucci. They and Krause (1944), who described a further case, remarked that mild degrees of the syndrome were probably more common than the small number of reported cases would indicate. Umansky (1946) has since described a mild case in a coloured girl, but notes that at the Hospital for Joint Diseases, New York, no other example of the combination was found in seventy-one cases of haemangiomata, sixty-five cases of dyschondroplasia and sixty cases of osteochondromata collected over a period of fifteen years. The case now reported, which appears to be the fifth of which an autopsy record is available, is unusual in that the base of the skull was involved.

Dyschondroplasia, or Ollier's disease, is characterised by a disturbance of bone formation in cartilage, particularly at the growing ends of the bone. There is no evidence that the condition is familial; the patients usually appear normal at birth, the disease being first noted at any time up to puberty. The lesions are often predominantly unilateral. The cartilage persists as islands in the diaphysis and may grow to form enchondromata; in some situations such as the phalanges, there may be great expansion and deformity of the bone. Ecchondromata are also formed, especially near the epiphysial lines. As a result of the imperfect ossification and irregular growth, bowing of the affected bones may lead to marked skeletal asymmetry, and the stresses of weight-bearing often cause secondary deformities. Owing to the delay in skeletal growth the patients are usually of small stature, and may show pronounced muscular atrophy. The lesions affect any part of the skeleton: involvement of the long bones and phalanges is common, of the skull, carpus and tarsus, uncommon. Fractures occur readily and may be slow to unite. Malignant change may develop in the chondromata.

The vascular abnormalities of Maffucci's syndrome consist of multiple cavernous haemangiomata and phlebectasia. The haemangiomata may occur in the subcutaneous tissue anywhere, but have also been noted in the lips, palate and mesocolon. They form blue or reddish-blue tumours which are soft, compressible, and sometimes tender on pressure. Thrombi may form and sometimes become calcified; as phleboliths they produce a striking radiographic picture in the soft tissues. Phlebectasia is common and may affect large groups of veins or be confined to a few local areas in a vein, causing bead-like swellings.

### CASE REPORT

The patient, a small, grossly deformed woman aged forty-seven years, had been found unconscious in bed and admitted to hospital with a diagnosis of subarachnoid haemorrhage. When examined, she co-operated in response to instructions but was partly aphasic, being able to answer little more than " yes " or " no."

*Previous history*—This was obtained from her brother. Her mother and father were unrelated and there were no known physical abnormalities in any near relatives. No deformities were noticed during early childhood, but at the age of seven a broken leg caused by a fall united with deformity; after this she wore irons on both legs and a raised boot on one side. When she was eleven years old, lumps were noticed on her hands and feet; they were excised but soon recurred. Another attempt at removal was made but the swellings again recurred and gradually increased in size. Many of the lumps were blue in colour but none of them ever bled. Fluid exuded from the swellings on her feet and affected the leather of her boots. She married at twenty-seven but there were no children and her husband died a few years later. She then took up hairdressing and was able to support herself until the lumps on her fingers made it impossible for her to hold the instruments. She had originally trained as a milliner, and up to the time of her final illness she was able to sew beautifully and to play the piano well. For five days before her admission she had complained of a spasmodic pain over the left eye; it had been noticed that her left eye moved upwards when she looked to the left.

FIGS. 1 and 2

Figure 1 (*left*)—A photograph of the feet, showing the haemangiomata on the toes. The bead-like subcutaneous swellings are localised varices. Figure 2 (*above*)—The right hand, showing swellings near the interphalangeal joints.

*Examination*—The patient was grossly deformed. The right leg was short, with forward bowing of the femur and a hard swelling at its lower end. The tibia was S-shaped, concave forwards above and convex forwards in the lower third. The ankle was fixed in plantar flexion and the knee and hip joints showed only slight movement; there was no crepitus in any of the joints. On the foot there were multiple soft tender tumours, bluish in colour and covered by horny skin; the largest were on the inner side of the heel and great toe, with smaller ones on the dorsum and sole of the foot (Fig. 1). Localised simple varices were also found, mainly round the ankle. The left leg was even more deformed, with outward and forward bowing of the femur. There was enlargement of the lower end of the femur, and also of the upper end of the tibia—which was nevertheless relatively straight. The foot was inverted and fixed in plantar flexion. There were soft swellings on the foot; one especially large growth on the medial aspect measured 7·5 by 5·0 centimetres. Bead-like swellings of the veins were

palpable in the subcutaneous tissue. The anterior surfaces of both legs showed a reticular pattern of deep brown pigmentation.

The right hand (Fig. 2) showed hard swellings covered by shiny skin of normal colour over the interphalangeal joints of the first, second and third fingers, and the proximal phalanx of the second finger appeared irregularly expanded. Otherwise the upper limbs showed no abnormality. On the abdominal wall above the left iliac fossa were several soft bluish growths, and three small tumours—" like raisin skins without pips "—were present on the skin of the thorax.

*Central nervous system*—There was complete ptosis of the left eyelid with some proptosis. The right pupil was central, circular and moderately dilated, with a brisk direct and consensual light reflex and normal reaction on convergence; the left pupil was dilated and fixed. The left eye moved only slightly in a lateral direction but was completely immobile when upward or downward movements were attempted; movements of the right eye were normal. There was no papilloedema; the retinal vessels appeared healthy and there were no haemorrhages or exudate.

The sense of smell was absent in the left nostril but present in the right. There was diminished sensibility in the area supplied by the fifth nerve on the left side, and the left corneal reflex was absent. The right lower facial muscles showed a definite weakness of upper motor neurone type. The hearing was normal and the movements of the tongue and palate showed no abnormality. Neck stiffness was marked, with pain on movement.

The right arm was powerless and spastic and showed brisker reflexes than the normal left arm. There was no sensory loss. The superficial abdominal reflexes were absent on the right, present on the left. The right leg was weak with a slight increase in tone. The knee and ankle jerks were present and equal on both sides. The right plantar response was extensor and the left flexor. Kernig's sign was not present. The heart, lungs and abdomen appeared normal; the blood pressure was 165/85.

The diagnosis of subarachnoid haemorrhage was confirmed by lumbar puncture, when blood-stained fluid under increased pressure was obtained. The patient lapsed into coma; three days after admission there was bilateral papilloedema and incontinence of urine and faeces. The neck stiffness persisted and the hemiplegia on the right side became complete. There was no elevation of temperature at any time. The patient died eleven days after admission.

The following investigations were carried out in hospital: *Radiographs (portable machine)*—All the bones with the exception of the skull, clavicles and spine showed the characteristic changes of dyschondroplasia (Figs. 3 to 5). In addition, there were multiple soft tissue tumours corresponding to the vascular dilations and haemangiomata, and small circumscribed calcifications due to phleboliths.

*Blood examination*—There was a moderate polymorphonuclear leucocytosis of 13,900 per cubic millimetre; serum calcium—10·4 milligrammes per 100 cubic centimetres; plasma phosphorus—3·0 milligrammes per 100 cubic centimetres; alkaline phosphatase—6·9 units (Jenner and Kay); blood urea—56 milligrammes per 100 cubic centimetres; serum protein—total protein 8·10 grammes per 100 cubic centimetres, serum albumin 5·60 grammes per 100 cubic centimetres; erythrocyte sedimentation rate 26 millimetres in one hour (Westergren). The urine contained no albumin or sugar.

**Autopsy**—An autopsy was carried out twenty-four hours after death. The deformities present have already been noted.

*The bones*—The right femur measured 30 centimetres in length. Its head was of normal size but showed erosion of articular cartilage. The shaft showed angulation of approximately 30 degrees at 8·0 centimetres below the greater trochanter, and between this and the lesser trochanter the shaft was expanded. The lower end was rotated medially on the shaft through

FIG. 3
The shaft of the right femur is twisted and its lower end greatly expanded.

FIG. 4
The right tibia and fibula. There are many phleboliths in the soft tissues of the foot.

FIG. 5
A radiograph of the right hand showing enchondromata.

an angle of about 45 degrees and the distal 8·0 centimetres were expanded to a maximum diameter of 7·0 centimetres. The lower articular surface was eroded. Section of the bone showed that the expansions were associated with chondromata in the diaphysis ranging from 0·2 to 2·5 centimetres in diameter. Where they occurred the overlying cortex was thinned and in places the neoplasms projected through the cortical bone. The epiphysial lines were not evident. Red bone marrow was scanty but subcortical streaks were present and reddish marrow was present at the periphery of the cartilaginous masses.

The right tibia measured 28·5 centimetres in length and was roughly S-shaped with expansion of the upper and lower ends caused by multiple chondromata up to 2·0 centimetres in diameter (Fig. 6). The right fibula measured 27·5 centimetres in length and showed on section a chondroma 2·0 centimetres from the head which had expanded the shaft and burst through the cortex to form a mass $4{\cdot}0 \times 3{\cdot}0 \times 5{\cdot}0$ centimetres in the soft tissues. At 5·0 centimetres from the lower end a collection of chondromata occupying an area 3·0 centimetres in diameter was present. The first right metatarsal showed a chondroma 0·7 centimetres in diameter in the centre of the shaft.

Chondromata were visible on the pleural surfaces of five ribs on the right side and four on the left side. The sternum showed multiple chondromata. No chondromata were found in the spine.

*Skull*—The vault showed no abnormality. Rising from the basi-sphenoid in the region of the sella turcica was a rounded nodular neoplasm 8·0 centimetres in width which projected upwards to a height of 5·0 centimetres (Fig. 7). The posterior part of the neoplasm was soft and infiltrated with blood. Anteriorly the capsular surface was smooth, glistening and yellowish-white in colour, with the pituitary stalk stretched over it and elongated to 3·0 centimetres. The tumour lay just to the left of the midline and distorted the structures at the base of the brain. The optic chiasma was stretched over the surface of the tumour, and

FIG. 6

A section through the upper end of the right tibia showing multiple chondromata and penetration of the cortex.

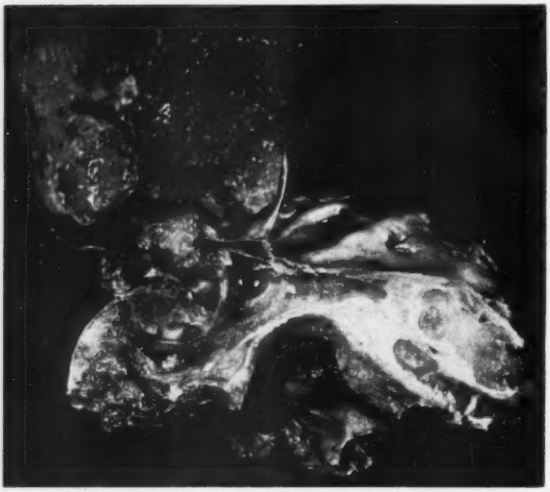

FIG. 7

A sagittal section of the base of the skull through the pituitary fossa, showing a haemorrhagic chondrosarcoma growing from the basisphenoid. The pituitary is largely necrotic.

the left side of the circle of Willis was markedly elongated. The pituitary appeared almost entirely necrotic. The basi-sphenoid contained several minute chondromata. There was thrombosis of the left cavernous sinus and blood had infiltrated along the sheath of the left optic nerve. The brain (1,235 grams) showed softening of the left basal nuclei; there were deep indentations from the neoplasm at the base and on the under surface of the left frontal lobe.

*Distribution of the cavernous angiomata*—These were found only in the subcutaneous tissues and in the synovial membrane of the joints of the lower limbs (the joints of the upper limbs were not opened). Many contained phleboliths. Of the subcutaneous angiomata, those on the feet projected considerably from the surface and were covered by hyperkeratinised epithelium. Those on the legs and abdominal wall did not project and many were not visible from the surface. In the joints the angiomata were eroding the adjacent bone; this was most marked in the patellae. In addition to the tumours, many of the leg veins showed a general phlebectasia.

*Other findings*—The uterus contained a solitary leiomyoma. The left ovary was replaced by a yellowish neoplasm measuring $3{\cdot}0 \times 2{\cdot}0 \times 1{\cdot}0$ centimetres. Both adrenals contained cortical adenomata measuring 2·5 centimetres in diameter. The other viscera showed no significant abnormality.

**Histological examination.** *Bones*—Apart from the intracranial neoplasm these showed the recognised picture of dyschondroplasia with large areas of hyaline cartilage covered by normal lamellar bone or by perichondrium (Fig. 8). The presence of haemopoietic marrow in the neighbourhood of the chondromata was confirmed.

The tumour arising from the base of the skull showed a much more cellular structure with occasional mitoses and tumour giant cells, and was regarded as a well-differentiated chondrosarcoma of low malignancy (Fig. 9). A great part of the neoplasm was the seat of recent haemorrhage.

*Haemangiomata*—Typical cavernous haemangiomata showed much organised thrombus with calcification (Fig. 10). The *ovarian tumour* was composed of cellular tissue having the characteristics of a theca-cell tumour (Fig. 11). *The adrenal tumours* were simple cortical adenomata. *The uterine tumour* was a simple leiomyoma. The endometrium was atrophic. *The pituitary* showed recent necrosis of almost the entire gland. None of the other organs was remarkable; particularly, the other endocrine organs including the parathyroids appeared normal.

## DISCUSSION

Maffucci's syndrome appears to originate from a mesodermal dysplasia. There is no evidence of familial incidence and there is nothing to suggest that either of the component abnormalities induces the other. The subjects usually appear normal at birth, the lesions becoming noticeable in childhood because of deformity, fractures, or the appearance of chondromata or haemangiomata. The disease progresses and gives increasing disability, but may become static after the growth period has ended. Malignant change in the chondromata is not uncommon; it occurred manifestly in four of the twenty-three recorded cases, and was probable in another two.

The present case is unusual in that the skull was involved. Only three of the other recorded cases showed such involvement; one of these showed a chondrosarcoma of the body of the sphenoid. The present case presented an interesting clinical picture caused by the intracranial neoplasm. The subarachnoid haemorrhage was due to haemorrhage into the tumour, leading to further interference with the already distorted arteries of the base of the brain and causing cerebral softening and hemiplegia. There was also cavernous sinus thrombosis; to this probably should be attributed the recent necrosis of the pituitary, although direct pressure on the gland with distortion of the stalk may have played some part. Walsh

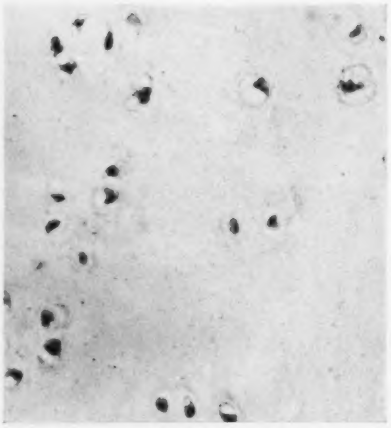

FIG. 8

H. & E., ×230. A section of a tibial chondroma showing the degree of cellularity (*cf.* Fig. 9).

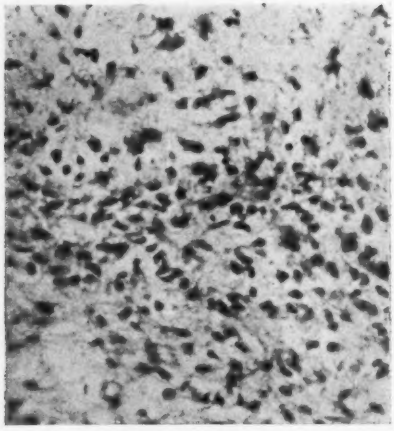

FIG. 9

H. & E., ×230. A section of the intracranial chondrosarcoma showing de-differentiation and greatly increased cellularity (*cf.* Fig. 8).

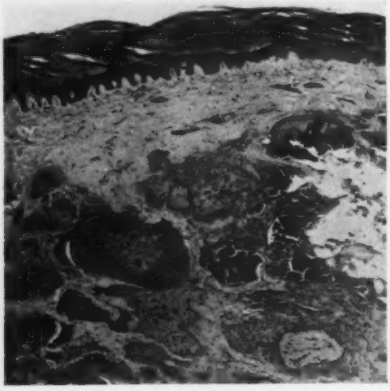

FIG. 10

H. & E., ×21. A section of a verrucous haemangioma showing marked hyperkeratosis and calcified phleboliths.

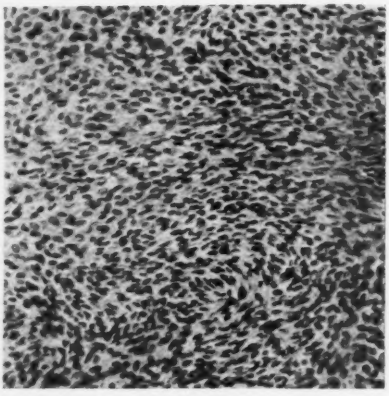

FIG. 11

H. & E., ×180. A section of the ovarian tumour, probably a thecoma, showing the very cellular fibromatous neoplasm.

(1937) described necrosis of the pituitary gland in five out of six cases of cavernous sinus thrombosis. It is difficult to assess the part played by the pituitary necrosis in the progress of the disease described here because the patient was so gravely ill.

The finding of other simple neoplasms in the adrenals, left ovary and uterus was of interest. The ovarian neoplasm was regarded as a thecoma, and it is unfortunate that there was no information regarding menstruation.

## SUMMARY

1. Maffucci's syndrome consists of dyschondroplasia (Ollier's disease) in association with cavernous haemangiomata and phlebectasia. Twenty-two cases have hitherto been described.
2. A further case is recorded with autopsy findings showing the characteristic features of the syndrome. Death was caused by a chondrosarcoma of the sphenoid, which led to subarachnoid haemorrhage, cranial nerve palsies, crossed hemiplegia and cavernous sinus thrombosis with almost total pituitary necrosis.

Our thanks are due to Dr A. G. Ogilvie for permission to publish this case, and to Dr Brian Houston for the radiological report.

## REFERENCES

CARLETON, A., ELKINGTON, J. ST. C., GREENFIELD, J. G., and ROBB-SMITH, A. H. T. (1942): Maffucci's Syndrome (Dyschondroplasia with Haemangiomata). Quarterly Journal of Medicine, **N.S. 11,** 203.
KRAUSE, G. R. (1944): Dyschondroplasia with Haemangiomata (Maffucci's Syndrome). American Journal of Roentgenology, **52,** 620.
MAFFUCCI, A. (1881): Movimento medico-chirurgico (quoted by Carleton *et al.*).
UMANSKY, A. L. (1946): Dyschondroplasia with Haemangiomata (Maffucci's Syndrome). Bulletin of the Hospital for Joint Diseases, **7,** 59.
WALSH, F. B. (1937): Ocular Signs of Thrombosis of the Intracranial Venous Sinuses. Archives of Opthalmology, **N.S. 17,** 46.

# A LARGE CALCIFIED LIPOMA OF THE THIGH

## Report of a Case

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*From the Royal Victoria Infirmary*

A man aged eighty-one years sought advice for a large swelling of the left thigh; it had been present for twenty-one years. One year after it had first been noticed, the tumour was excised, but there was no record of its nature. The swelling recurred a year later and became larger gradually. During the five years immediately previous, growth had been more rapid, with extension into the popliteal region; more recently still there had been pain.

*Examination*—There was a large mass on the front of the thigh and extending round the lateral aspect to the popliteal fossa (Fig. 1). It reached from the upper third of the thigh to

Fig. 1

The pre-operative photograph.

the level of the knee joint. There was a healed scar over the lower part of the tumour, which had displaced the patella forward. Many dilated veins were seen over the swelling, and a fluctuant area could be detected in its upper part. The mass was not attached to skin or to bone. Hip movements were normal but flexion of the knee was limited to 60 degrees. The foot was cold and pale, and the peripheral pulses almost impalpable. By contrast the right leg and its arterial pulses were normal.

*Radiographs* showed a large soft tissue swelling round the lower two-thirds of the femur, with areas of calcification (Fig. 2). There was no evidence of active bone formation or destruction but there was a suggestion of pressure atrophy of the cortex of the femur just above the medial condyle (Fig. 3). The radiographic appearances were those of calcification in a benign tumour such as a lipoma. Radiographs of the chest showed atheromatous changes in the aorta but no evidence of active pulmonary or mediastinal change.

No immediate treatment was advised. Three months later, however, there was venous congestion and oedema of the limb below the swelling, with early ulceration at the base of the fifth toe. Pulsation in the posterior tibial and dorsalis pedis arteries could not be felt.

Amputation was performed just above the swelling. The stump healed by first intention, and six months later the patient is alive and well.

Pathological examination showed a lipoma, weighing 5,200 grammes and measuring 18 centimetres in diameter. The tumour contained many areas of calcification from 2 to 5 centimetres in diameter, and numerous small cystic spaces. There was no evidence of malignant change and the bone of the femur appeared normal.

*Comment*—It seems certain that the tumour was a lipoma which had recurred after incomplete removal twenty years previously. The two features of particular interest were the extensive areas of calcification in the tumour and the vascular obstruction it caused. Calcification in a

FIG. 2

FIG. 3

Figure 2—The lateral radiograph. Note the displacement of the patella. Figure 3—The antero-posterior radiograph. Note the suggestion of pressure atrophy of the lower femoral shaft.

lipoma was described by Virchow (quoted by Aird 1949) under the term *lipoma petrificum ossificans*. Infiltrating lipomas of the posterior tibial region have been reported by Regan, Bickel and Broders (1946) but calcification was not observed. In one of their patients the tumour had recurred after removal.

I am indebted to Mr John Brumwell for permission to publish this case, and to Dr J. H. Middlemiss for the radiological report.

## REFERENCES

REGAN, J. M., BICKEL, W. H., and BRODERS, A. C. (1946): Infiltrating benign lipomas of the extremities. Proceedings of the Staff Meetings of the Mayo Clinic, **21**, 75.

VIRCHOW—Quoted by AIRD, I. (1949) in A Companion in Surgical Studies. Edinburgh: E. & S. Livingstone Ltd. 79.

# BILATERAL PERILUNAR DISLOCATION OF THE CARPUS

## Report of a Case

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*From the Department of Orthopaedics, Dunedin Hospital*

Perilunar dislocation of the carpus is an unusual injury of the wrist joint, and a bilateral case is so rare that it is worthy of report. In this injury the lunate bone remains in normal relationship with the radius but the other carpal bones and the rest of the hand are displaced backwards, usually to the radial side. The tip of the radial styloid process is sometimes fractured and displaced with the carpus, and the tip of the ulnar styloid also may be avulsed. Reduction is achieved by simple traction and manipulation, and the wrist is immobilised in plaster for three or four weeks.

The patient was a ship's carpenter. In September 1946 he fell down the hold of a ship and struck both wrists on the edge of the well of a lower deck before reaching the bottom. In addition to multiple minor injuries, he sustained fractures of the mandible and skull, and injuries of both wrist joints. On the right side there was an uncomplicated perilunar dislocation of the carpus (Fig. 1); on the left there was a similar dislocation with fracture and displacement of the tip of the radial styloid process (Fig. 2).

The dislocations were reduced by traction and manipulation. Normal relationship of the carpal bones was restored on both sides and the detached fragment of the right radial styloid process was accurately reduced. The joints were immobilised in plaster for four weeks, and physiotherapeutic treatment was then begun.

On review three years after the injury it was found that there was for all practical purposes full return of function in the left wrist, and radiographic examination showed no residual damage. In the right wrist there was slight limitation of the extremes of movement; radiographic examination again showed normal appearances (Fig. 3).

FIG. 1

Antero-posterior, oblique and lateral radiographs of the right wrist, showing perilunar dislocation of the carpus.

FIG. 2

Antero-posterior, oblique and lateral radiographs of the left wrist, showing perilunar dislocation with fracture of the radial styloid process and a chip detached from one of the carpal bones.

FIG. 3

Antero-posterior radiographs of the left and right wrists three years later.

# NON-UNION OF THE TRIQUETRUM

## Report of a Case

F. C. Durbin, Exeter, England

Fractures of the triquetrum are uncommon. The literature of the injury has been reviewed by Greening (1942); and its anatomy and mechanics was later discussed by Bonnin and Greening (1944), who described two types, a compression fracture and a traction fracture. A transverse fracture was noted by Fairbank (1942), who observed that it did not unite quickly and required prolonged immobilisation in plaster. The case described here is of interest because it shows established non-union of a transverse fracture.

In May 1948, a stoker aged twenty-two years was playing football and fell backwards on to his left wrist, which was forcibly dorsiflexed and became very swollen and painful. Three days later he attended hospital for advice; radiographs were taken (Fig. 1) but were reported to show no fracture. A crêpe bandage was applied and he was instructed in wrist and finger exercises. He was able to return to work fourteen days after injury, but slight pain in the wrist persisted. In October 1948 he sustained a minor injury to the same wrist at work and returned to hospital at once. On examination there was then a little swelling of the wrist and all movements were painful, particularly dorsiflexion and ulnar deviation. Radiographs

Fig. 1

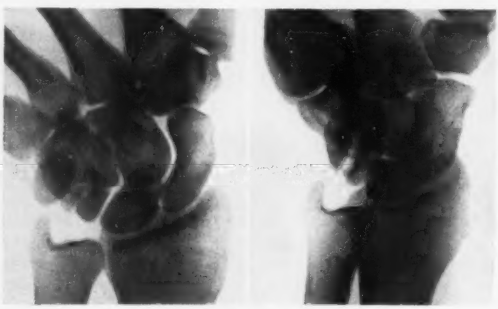

Fig. 2

Figure 1—The antero-posterior radiograph taken soon after injury. The fracture line, which is obscured by the shadow of the pisiform, can just be seen crossing the long axis of the triquetrum transversely.
Figure 2—Antero-posterior and oblique radiographs eight months after injury. Some marginal sclerosis is apparent in the oblique view, which shows the fracture clearly.

showed a transverse fracture of the triquetrum with established non-union. A review of the original radiographs showed a transverse fracture without displacement. An oblique view had not been taken after the original injury, but the fracture line was quite obvious in one taken subsequently (Fig. 2).

After the wrist had been immobilised in plaster for three months, still no alteration could be seen in the state of union; the plaster was therefore discarded and movement allowed. When last seen, the patient had returned to full work; wrist movements were only slightly restricted but there was pain on forcing dorsiflexion and adduction.

REFERENCES

Bonnin, J. G., and Greening, W. P. (1944): British Journal of Surgery, **31**, 278.
Fairbank, T. J. (1942): British Medical Journal, **2**, 310.
Greening, W. P. (1942): British Medical Journal, **1**, 221.

# EXCISION OF THE SHAFT OF THE TIBIA FOR SARCOMA

## Examination of a Patient Forty-three Years after Replacement by a Fibular Graft

FRANCISCO GENTIL, LISBON, PORTUGAL

On August 4, 1906, I resected the left tibial diaphysis of a girl aged fourteen years for sarcoma diagnosed clinically and radiologically (Figs. 1 and 2). The segment excised was replaced by a graft of equal length from the fibula, the soft tissue attachments of which were disturbed as little as possible during mobilisation in order to preserve the blood supply. My reason for undertaking conservative resection was that the sarcoma was a central one, limited to the bone and showing no soft tissue invasion. Histological examination of the tumour showed a uniform structure. It consisted of connective-tissue spindle cells set in several directions, with an abundant vascular stroma. In several places, but mostly where the stroma was abundant and the fusiform cells scanty, there were groups of six or more giant cells. These were similar to the *myeloplaxes* of the bone marrow, from which they were probably derived. There were also some areas of degeneration, where the stroma was granular and its reaction—distinct from the acidophil reaction of the rest of the tumour—was basophil.

Since the first published report of this case in 1907 it has been referred to by several writers, some of whom have doubted the accuracy of the diagnosis. Cavaillon and Alamartine

FIG. 1
The pre-operative radiograph taken in 1906.

FIG. 2
The specimen after removal.

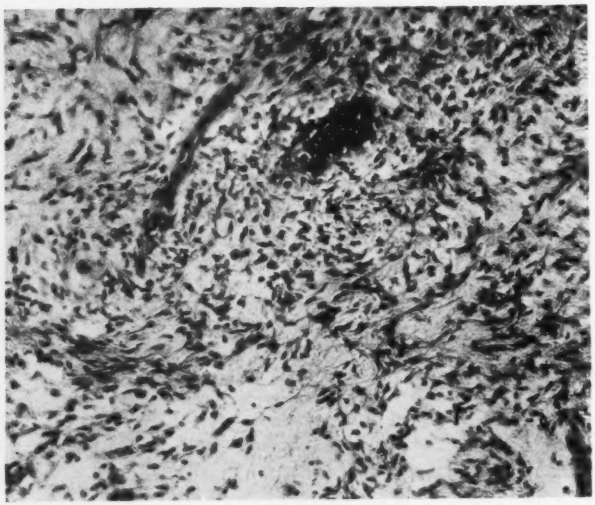

FIG. 3
A photomicrograph of the tumour taken in 1949 (×75).

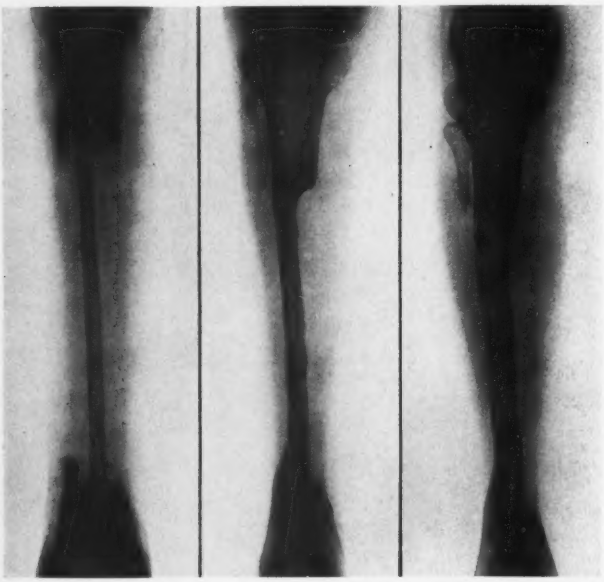

FIG. 4
Radiographs shortly after operation, and twenty and forty-three years later.

(1909) and, more recently, Nové-Josserand and Tavernier (1927) have referred to the case as one of osteitis fibrosa.

For this reason we have re-examined the original material and have submitted the specimens for independent histological examination (Fig. 3). Professor Georges Gander reports: "Tumour of the tibial diaphysis, fusiform in shape, 23·5 centimetres long and 5 centimetres in diameter. The tumour invades the marrow and the bone as far as the periosteum. Histologically the tumour is composed of small fusiform or triangular cells with small nuclei, either round or elongated. Chromatin is atypical in quantity and distribution.

FIG. 5
The left leg forty-three years after operation.

Mitotic figures are numerous. In several places osteoid transformation of these elements is seen. In general the walls of the blood vessels are formed by tumour cells, endothelium being seldom present. In one place giant cells of osteoblastic type are seen. Areas of calcification are present in the osteoid tissue, and at some points there are groups of osteoblasts. It is a sarcoma of osseous origin and fibroblastic and osteoblastic type." This report confirms the original diagnosis of sarcoma; and it is worthy of note that resection and replacement by a fibular graft were successful.

Now, forty-three years after operation, the condition of the patient remains satisfactory. It is interesting to compare the radiographs taken immediately after the operation with others taken twenty and forty-three years later (Fig. 4). Walking is normal, and so, apart from some shortening, is the general appearance of the leg (Fig. 5).

## REFERENCES

CAVAILLON, P., and ALAMARTINE, H. (1909): Lyon Chirurgical, **2**, 177.
GENTIL, F. (1907): Gazeta dos Hospitais do Porto, No. 1, Anno 11.
GENTIL, F. (1929): Lyon Chirurgical, **26**, 465.
NOVÉ-JOSSERAND, G., and TAVERNIER, L. (1927): Tumeurs Malignes des Os. Paris: G. Doin et Cie.

# AMPUTATION ABOVE OR BELOW THE KNEE FOR PRIMARY PERIPHERAL VASCULAR DISEASE

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It was found at Queen Mary's Hospital that many patients with below-knee amputations for primary peripheral vascular disease returned with ulcerated and painful stumps. Most of these patients had undergone sympathectomy which, it was supposed at first, might have some connection with their subsequent troubles. An investigation was held, therefore, during which ninety-five patients were seen who had suffered amputation for thrombo-angiitis obliterans or arterio-sclerosis in many different hospitals. There was no selection of cases except that diabetes and other causes of gangrene were excluded. The inquiry into the cause of painful ulceration of the below-knee stump, though it failed to show a correlation with sympathectomy, revealed a method for determining the proper level of amputation.

**Distinction between thrombo-angiitis obliterans and arterio-sclerosis**—The diagnostic criteria used to distinguish these two conditions were: 1) *The age at the onset of the disease*—Leriche (1947), quoted by Boyd *et al.* (1949), says that "true thrombo-angiitis obliterans occurs before the age of thirty-five. Arterio-sclerosis occurs over the age of fifty, but in between there is a group of cases showing features common to both." All these three groups were found in the present series. 2) *Impairment of the circulation in the hand*—Allen, Barker and Hines (1946) have pointed out that in arterio-sclerosis impairment of circulation in the hand is rare; in thrombo-angiitis obliterans, nevertheless, it was found in 40 per cent. of their cases. A like proportion was found in the present series. 3) *Hypertension*—This is rarely found in the early course of thrombo-angiitis obliterans, but is frequent in arterio-sclerosis. 4) *Calcification of arteries*—Calcification is more common in arterio-sclerosis than in thrombo-angiitis obliterans. 5) *The gross and microscopic appearances of the vessels in the amputated limbs*—These are almost conclusive, though this view is challenged by Boyd *et al.* (op. cit.).

The ninety-five cases studied included forty-three bilateral amputations, and so there were 138 stumps. Apart from three amputations of toes only, eighty-three stumps were above the knee, and fifty-two below. Twenty-nine unsatisfactory below-knee stumps had already been re-amputated above the knee, making a total of eighty-one primary below-knee stumps.

**Classification of stumps**—Three criteria were used: *The state of the skin* (3=normal; 2=thin, shiny or scaly; and 1=ulcerated). *Pain* (3=none; 2=occasional; 1=persistent). *The ability to wear an artificial limb* (3=unimpaired; 2=impaired for some of the time only; 1=impossible). Stumps graded 3 under each heading were classed as satisfactory. Of the eighty-three above-knee stumps, seventy-five were satisfactory and eight were not. Of the eighty-one below-knee stumps, twenty-nine had already been re-amputated above the knee, twenty-seven were satisfactory and twenty-five remained unsatisfactory. What is striking is not so much the preponderance of good above-knee amputations, as the fact that one-third of the below-knee stumps remained satisfactory. Thus, in a disease notoriously affecting both lower limbs there is sometimes a reasonable chance of conserving a substantial part of the limb and so avoiding the great disability caused by amputation through both thighs.

**The cases in which below-knee amputation offers a reasonable prospect of success**—Relevant factors in selecting these cases are: 1) *Age*—All the satisfactory below-knee stumps were in patients under the age of fifty-two years at the time of amputation. All of the nine older patients had defective stumps. 2) *The popliteal pulse before operation*—Of fifteen patients

in whom the pulse was known to have been present before operation, only one showed an unsatisfactory stump. In all fifteen cases bleeding at operation was very brisk. The single unsatisfactory stump ulcerated eighteen months after amputation during a recrudescence of thrombo-angiitis which also involved the fingers of both hands. Popliteal pulsation was seldom found in these patients later than six months after amputation: the post-operative absence of a pulse is therefore of little significance. The pre-operative absence of the popliteal pulse is not in itself an omen of failure, however, for there were thirteen satisfactory stumps in this group. At operation bleeding had again been profuse and the muscles had appeared healthy. 3) *The vascularity of the part as seen at operation*—This was the crucial factor. If bleeding had been brisk the stump proved satisfactory, but after little or no bleeding the stump proved unsatisfactory. This applied to both above- and below-knee stumps. Survival depends therefore on the state of the circulation, main or collateral. Some simple and reliable means of assessing the circulation before operation should indicate when a below-knee amputation is likely to be successful.

**Assessment of circulation before operation**—Three tests were employed: 1) *The skin temperature as determined by palpation*—An obvious boundary between warmth and cold is frequently found in limbs when symptoms and signs indicate amputation. 2) *Reactive hyperaemia* (Lewis 1946)—The limb is elevated until it is pallid, and a sphygmomanometer is then placed round the thigh and inflated to above the systolic pressure. After an interval of not less than five minutes, during which the limb is kept warm, the sphygmomanometer is released and the zone of flushing that occurs within five minutes is observed. 3) *Oscillometry*—This provides useful but only confirmatory evidence, particularly of the absence of pulsation immediately above and below the knee.

**Assessment of circulation at operation**—The final criterion, if the tests indicate the possibility of a successful below-knee amputation, is the state of the circulation as observed at operation. In order to eliminate the possibility of vascular spasm, no tourniquet should be used. Free bleeding shows that the stump should survive. The appearance of the muscle is also important. If it is pinkish-grey, homogeneous, and does not bleed, it is useless to proceed with amputation below the knee. There must inevitably be borderline cases, but it should be safe to proceed if the colour of the muscle is normal, and if the cut surface is covered by an ooze of blood immediately after swabbing.

In this series, four cases examined fully before amputation satisfied the criteria both before and at operation, and all have satisfactory below-knee stumps. It was noted in each of them that the temperature boundary found at palpation and the lower limit of the rapid hyperaemic flush coincided with the level below which the muscle was ischaemic. *In each case the site of amputation was more than six inches above this zone.*

**The length of the stump**—This has some bearing on the survival of the stump, which should be as short as can be compatible with satisfactory limb-fitting. The lengths of the satisfactory below-knee stumps, measured from the joint line, varied from four to six inches. A four-inch stump seldom presents any problem to the limb fitter, and does not reduce the efficiency of the artificial limb. Stumps shorter than this do present problems. The four-inch stump is rather more square than the conical one after amputation at the site of election, but tight bandaging produces good distal shrinkage. There is no indication for excision of the fibula, which provides an eccentricity of outline tending to prevent rotation of the prosthesis—a matter of particular importance if the amputation is bilateral.

**Unsatisfactory below-knee stumps**—The fifty below-knee stumps which actually ulcerated were all ischaemic, that is to say they were cold and there was no demonstrable circulation. Forty-two ulcerated within a year of amputation. Three stumps broke down after two years as a result of direct accidental injury. Figure 1 shows the time at which stumps broke down and also the length of survival of the other below-knee stumps in the series. It seems that if a below-knee stump is going to give trouble spontaneously, it will do so *within the first year.*

Furthermore, re-amputation below the knee offers little prospect of success. There were seventeen cases in which this had been done and *none was successful*; two of them had been trimmed more than once—a finding that does not encourage the practice of making a stump long enough to allow below-knee trimming in the event of failure.

**Unsatisfactory above-knee stumps**—Of the fifty-four unsatisfactory below-knee stumps, twenty-nine had been re-amputated above the knee; twenty-three of these were satisfactory. The remaining six re-amputations were not, again because of ischaemia; all the stumps were long, and four of these patients had pain indistinguishable from that of intermittent claudication. It is clear, therefore, that even in thigh amputations the state of the circulation must be the guide to the level of resection.

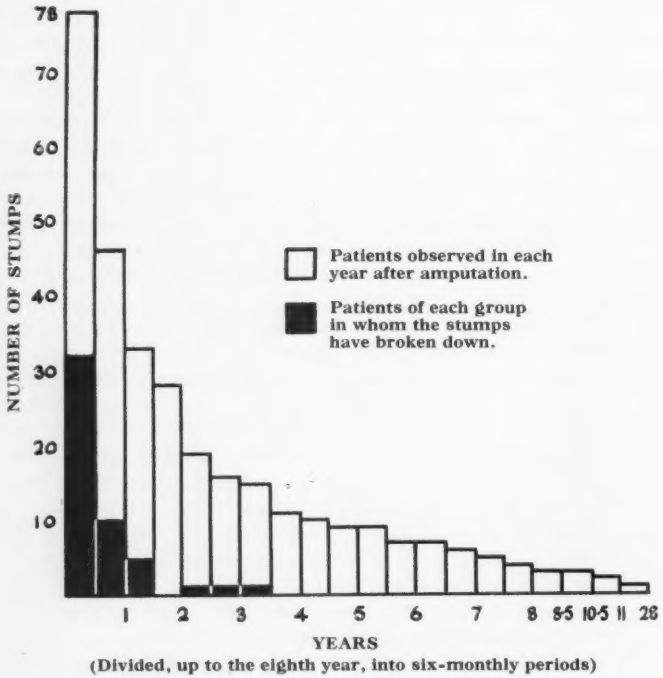


FIG. 1

A histogram to show: the six-monthly periods during which fifty out of seventy-eight below-knee stumps ulcerated; and the length of survival of the remaining satisfactory stumps.

## SUMMARY

1. An attempt has been made to rationalise the selection of the site of amputation for gangrene in primary peripheral vascular disease.

2. There is a good chance of the survival of a below-knee stump if the circulation in the skin of the proposed flaps appears adequate clinically, and if the blood supply to the muscles is obviously good at amputation.

3. If the popliteal pulse is present before operation, below-knee amputation should succeed. The absence of a popliteal pulse, however, does not exclude below-knee amputation.

4. Below-knee stumps should be about four inches long in amputations for peripheral vascular disease.

5. Tests for determining the state of the circulation are also necessary before choosing the level for above-knee amputations.

I am indebted to the Director General, Ministry of Pensions, for permission to publish this paper; to Mr H. J. Seddon and Mr St J. D. Buxton for their help in its preparation; and to the medical staffs of Queen Mary's Hospital, Roehampton, and of Chapel Allerton Hospital, Leeds, for access to patients under their care. The Institute of Orthopaedics provided a grant to cover expenses.

## REFERENCES

ALLEN, E. V., BARKER, N. W., and HINES, E. A. (1946): Peripheral Vascular Diseases. Philadelphia and London: W. B. Saunders Company, 384.

BOYD, A. M., RATCLIFFE, A. HALL, JEPSON, R. P., and JAMES, G. W. H. (1949): Intermittent Claudication. Journal of Bone and Joint Surgery, **31–B,** 328.

LERICHE, R. (1947): Medical Research in France during the War 1939–45. Editor, J. Hamburger. Paris: Editions Médicales Flammarion, 275.

LEWIS, T. (1946): Vascular Disorders of the Limbs. Second edition. London: Macmillan and Co. Ltd., 15.

# EXPERIMENTAL RUPTURE OF THE MEDIAL COLLATERAL LIGAMENT OF THE KNEE

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Severe injuries to the ligaments of the knee joint have recently begun to attract attention as a promising field for early reparative surgery. Palmer (1938) rationalised the diagnosis of these injuries and described the technique of surgical repair. Since then several further contributions, mostly from abroad, have supported early operation. In Britain, to judge from the literature, most surgeons prefer conservative treatment in the form of prolonged immobilisation. Whichever method is advocated, healing seems to be taken for granted, despite the scantiness of our knowledge both of the precise effect of injury on ligamentous tissue and of its reparative power. This paper describes an investigation which has been undertaken to determine firstly, the anatomical result of rupture of a ligament, and secondly, the response in the ligament to repair the damage. From this information it was hoped to obtain evidence for or against early operative repair.

## EXPERIMENTAL METHOD

Experiments were carried out on the medial collateral ligament of the knee joint of the cat. This is very similar anatomically to its human counterpart, and the vascular pattern, as determined by indian ink injections, is almost identical.

Under anaesthesia the ligament was ruptured by forcible abduction of the extended knee over the edge of the operating table. The medial side of the knee joint was immediately explored to determine the exact nature of the injury to the ligament and surrounding tissues. Displaced tissue in most cases was smoothed back into place but was not sutured; in a few cases displacement was allowed to persist. The wound was closed, but the limb was not immobilised. At varying intervals after rupture, the knees were re-explored, the naked eye appearance of the damaged area was determined and the ligaments were removed for microscopic examination. The animals were then killed.

## PATHOLOGICAL ANATOMY

Normal ligament is composed of dense, relatively acellular and regular collagen tissue. The fibres are arranged in parallel longitudinal bundles separated by scanty areolar tissue, just sufficient to allow slight gliding movement between the bundles and to transmit the very sparse capillary vessels which run longitudinally through the substance (Fig. 1). The medial ligament is invested superficially by a thick layer of loose areolar tissue which covers the joint capsule and forms an incomplete sheath for the ligament. This tissue is very vascular, and from it small vessels enter the ligament. The deep surface of the ligament lies in relation to the synovial reflections above and below the meniscus, from which a small subsidiary blood supply is derived by the deep fibres, particularly in the upper segment. No vessels enter through the bony attachments. Elastic fibres are absent from the ligament itself, but are found in the loose areolar covering.

Rupture of the medial ligament was produced in nineteen experiments. In every instance the long band ruptured along a definite line without detachment of bone flakes. The tears occurred close to the lower attachment six times and at the upper attachment seven times. In the remaining six cases an oblique tear involved the whole length, leaving two long triangular tongues of ligament. Stretching or rupture of fibres at many different levels has been

described but was not seen. In several of the long oblique tears the impression of stretching was given at first sight, because the loose areolar covering remained intact and continued to contain the fragments of ligament. But when the covering layers were divided and the ligament was exposed, the complete rupture was always discovered.

The ends of the ligament always recoiled. When the tear was oblique the two parts recoiled towards the attachments, but remained in contact with one another because of the nature of the rupture. In the transverse tears a wide gap was frequently found (Fig. 2). The body of the ligament was usually tortuous and curled up under the areolar sheath. Fibre bundles were disrupted and frayed, and microscopically the individual fibres assumed a fine wavy appearance in contrast with normal ligament collagen (Fig. 3). These changes often involved the whole length of the ligament. Associated damage to the joint capsule was variable, and was least in the lower end ruptures. When the upper end of the ligament parted, it was found to be torn away from the capsule on one or both sides down to the level of the joint, where the tear frequently involved the synovial membrane above the meniscus and laid the joint open.

Displacement of the ends of the ligament is obviously important in influencing healing. It is probably caused by momentary persistence of the abduction violence which ruptures the ligament so that the ends are separated inside the elastic areolar covering. This then grips the fragments and prevents them from falling back into place when the joint resumes a normal position. Immediately after the injury replacement of the tissue without undue

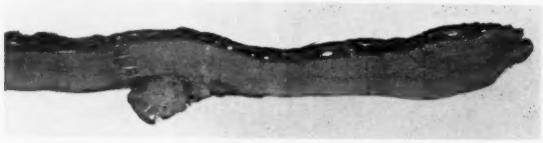

FIG. 1

Normal medial collateral ligament of the knee joint of a cat. Low power ($\times 4\frac{1}{2}$), showing upper half of ligament.

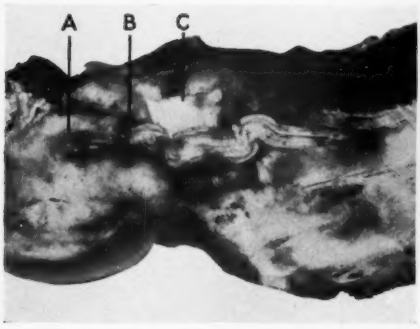


FIG. 2

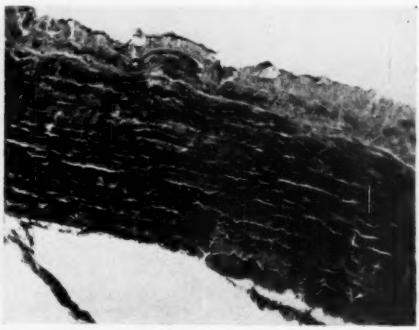

FIG. 3

Figure 2—Rupture of a ligament at the upper attachment ($\times 1\frac{1}{2}$). Dissection was performed after fixation in formalin immediately after injury. The original attachment is seen at *A* with a tiny strand still attached; *B* indicates the stump of the ligament which has recoiled almost to the level of the meniscus; curling and disruption of bundles are well shown; *C* marks the semi-membranosus tendon. Figure 3—Section remote from the rupture shows the widespread disruption and the fine wavy appearance of the collagen bundles ($\times 75$).

tension is easy because of the inelastic nature of the tissue, but in seven to ten days the retracted ligament shrinks and the tissue becomes oedematous and friable. Curling disappears and the individual fibres lose their fine wavy appearance. It is no longer possible to close the gap accurately and sutures will not hold. There is, therefore, only a brief opportunity for performing satisfactory surgical repair.

## THE PROCESS OF HEALING

When conditions were favourable, the torn ligaments healed in the manner described in detail by Mason and Shearon (1932) in their studies of tendon injuries. Ligamentous tissue is almost identical with that of tendon, but the physical effects of injury are much greater in the former. The rupture gap fills with blood. Proliferation of cells from the loose areolar tissue quickly converts the clot into granulation tissue supporting the torn ends of the ligament (Fig. 4). At the same time an intense cellular reaction begins in the previously almost acellular tissue of the ligament, and blood vessels, hitherto almost unseen, become numerous. This cellular and vascular reaction may affect the whole length of the ligament.

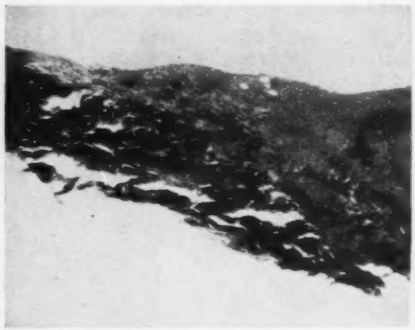

FIG. 4

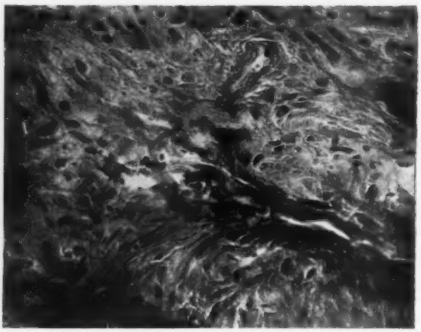

FIG. 5

Lower end tear seven days after injury. Figure 4—The tissue has broken under the microtome. Granulation tissue fills the zone of rupture (×40). Figure 5—Early multiplication of ligament cells and budding of collagen fibrils from a strand of ligament suspended in granulation tissue (×300).

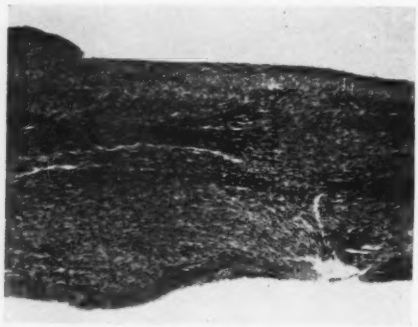

FIG. 6

Oblique tear fourteen days after injury (×40). Intense cellular and vascular reaction is seen in the ligament. Leashes of new collagen fibrils with regular longitudinal orientation bridge the gap.

After four or five days, proliferation of the ligament cells begins with the formation of fine new collagen fibrils (Fig. 5). Cells and fibrils migrate from the torn ends into the granulation tissue until the gap is bridged by collagen tissue, which quickly assumes a regular longitudinal arrangement. After two weeks the granulation tissue is replaced by well-developed parallel collagen fibres of immature type, continuous with the original ligament fibres, and the torn ends can no longer be distinguished (Figs. 6 and 7). After three weeks there is good tensile strength, and little abnormal lateral mobility can be demonstrated. Thereafter cells and blood vessels gradually diminish in number, while collagen fibres increase in size and strength and begin to assume arrangement into bundles. Thickening of the areolar tissue covering subsides, and the tissue separates into layers (Fig. 8). Within seven to eight weeks the ligament appears virtually normal to the naked eye except for slight local thickening and possibly some surface adhesions. Microscopically an increase in cells and blood vessels is noted for many weeks after injury (Fig. 9).

This process represents healing by regeneration of regular collagen tissue from the ligament fibres so that continuity and an almost normal state are restored. It was found in

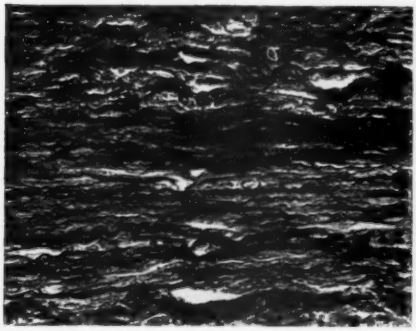

FIG. 7

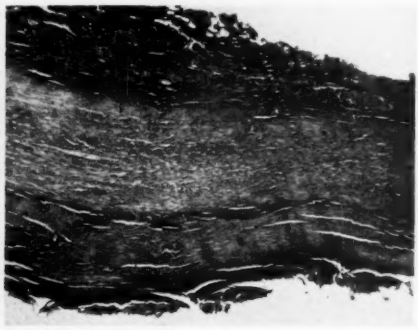

FIG. 8

Figure 7—Oblique tear seventeen days after injury (×300). The miniature young fibrils can be seen. The termination of the original ends of the ligament can no longer be distinguished. Figure 8—Lower end tear forty-nine days after injury (×40). The areolar tissue is still thickened but is separated into layers again. The rupture has healed by regeneration of regular collagen tissue which is beginning to approach normal. Cells and capillaries are still numerous.

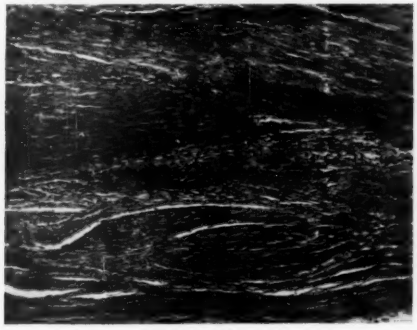

FIG. 9

Oblique tear sixty-three days after injury (×75). Cells and vessels are still very numerous. The collagen tissue is mainly well orientated and is beginning to separate into bundles.

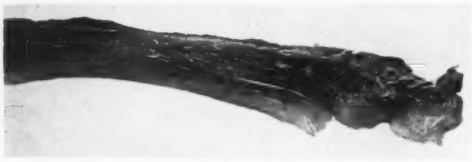

FIG. 10

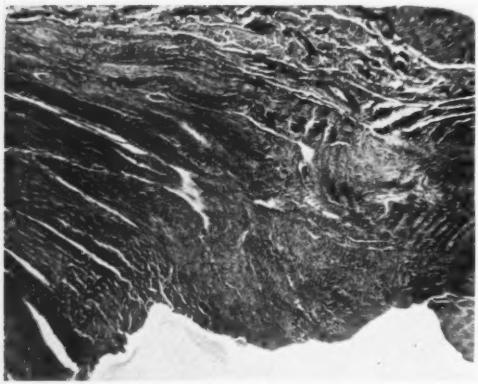

FIG. 11

Upper end tear 147 days after injury. Figure 10—The upper attachment of the ligament has curled in preparation of the specimen (×4½). It is represented by a mass of scar tissue in which the retracted end of the ligament ends abruptly. Figure 11—The stump of ligament ends in an irregular scar which has filled the gap. There has been no attempt at regeneration from the end of the torn ligament which can still be clearly recognised (×45).

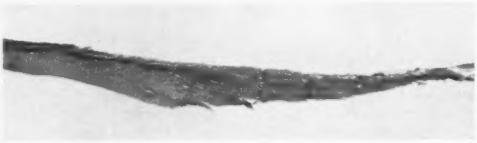

FIG. 12

FIG. 13

Upper end tear seventy days after injury. Figure 12—The greatly elongated attachment to the femoral condyle is well shown (×4½). Compare the attachment of the normal ligament in Figure 1. Figure 13—The long gap has been bridged by new collagen fibres with regular longitudinal orientation. These arise from the superficial part of the ligament. The deep fibres are deeply stained and quite inactive in contrast with the regenerated zone in which cells and vessels are still numerous (×45).

every case of *oblique* rupture in which the overlapping ligament fragments remained in close approximation. It was also noted in all but one of the *lower end* ruptures. The one failure was in a case in which wide displacement of the ligament was allowed to persist at the original exploration. Examination after two weeks disclosed a large organising haematoma between the torn ends, in which the ligament fibres became lost. Displacement of the tissue was the obvious cause of failure.

The group of *upper end* ruptures presented a very different picture. Five were examined at an interval of three weeks or more after injury; four of these had healed by formation of diffuse irregular scar tissue devoid of orderly arrangement. Of the four cases, one was similar to the single failure noted in the lower end ruptures; wide displacement was allowed to persist and the ligament tissue became lost in a mass of irregular scar. The remaining three showed similar characteristics. A moderate gap was filled with irregular scar in which the ligament stump terminated abruptly (Fig. 10). The normal cellular and vascular reaction to the injury was seen in the lower part of the ligament, but in the part adjacent to the rupture it was remarkable for its absence (Fig. 11). The tissue appeared quite inert, and vacuolation in the few cells seen suggested that it was undergoing ischaemic necrosis. One case only showed any attempt at healing by regeneration of regular collagen tissue. Here a long gap was found to be bridged by longitudinally arranged new fibres which arose from the superficial half of the ligament. The deep half of the original ligament was inactive and devoid of cells and vessels (Figs. 12 and 13).

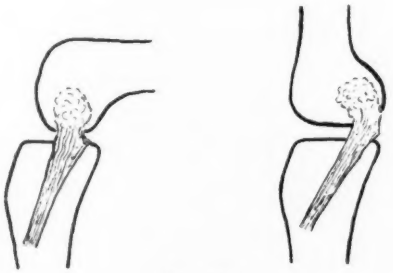

FIG. 14

Diagram to show the effect of adhesion of the ligament to the femoral condyle, the adhesion having occurred in the position of flexion. When the knee is extended, the whole ligament moves back with the femoral attachment.

This high incidence of failure of regeneration in upper end ruptures may have been due in part to persistent displacement of tissue. A tear at the upper attachment is much more likely to be affected by movement of the knee after injury, because the upper end of the ligament is the " working " end about which the femur rotates. In every case of upper end rupture the upper part of the ligament from the level of the meniscus to the normal attachment was represented macroscopically by a mass of scar tissue adherent to surrounding tissues and to the femoral condyle over a long area. The scar anchored the upper third of the ligament to the femoral condyle, so that when the knee was flexed and extended the ligament rotated with the femur (Fig. 14). The scar had little tensile strength, and it was possible to demonstrate lateral rock long after injury. But there can be little doubt that the main reason for failure of regeneration in upper end ruptures is interference with the blood supply to the torn end of the ligament caused by disruption of the ligament bundles and by the associated injury to the areolar covering and synovial membrane from which the blood supply is derived.

## CONCLUSIONS

Rupture of a ligament usually occurs along a definite line, but is associated with considerable intrinsic damage to the remote parts of the ligament. In spite of this, healing occurs by regeneration of regular collagen to form a new ligament with good tensile strength, provided the ends of the torn ligament are in reasonable apposition, and provided the blood supply is adequate.

When lateral instability of the knee after a recent injury suggests that a collateral ligament has been ruptured, wide displacement of the torn ends should be suspected. Accurate replacement can be guaranteed only by surgical intervention; operative repair therefore seems to be justifiable on anatomical grounds. If operation is contemplated it should be undertaken within the first week after injury when it is easy to achieve accurate repair, which later becomes impossible because of shrinkage and friability of the tissue. In order to preserve blood supply, the areolar covering should be disturbed as little as possible, and the least possible amount of fine suture material should be used to anchor the torn ends in position. Nevertheless when the tear involves the upper attachment, ischaemia of the damaged ligament may prevent normal healing, whatever the treatment adopted.

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### REFERENCES

MASON, M. L., and SHEARON, C. G. (1932): The Process of Tendon Repair. Archives of Surgery, **25,** 615.

PALMER, I. (1938): On the Injuries to the Ligaments of the Knee Joint. Acta Chirurgica Scandinavica, **81,** supplement **53,** 3.

FROM AN ATLAS OF GENERAL AFFECTIONS OF THE SKELETON

# 17. FIBROCYSTIC DISEASE OF BONE

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In arriving at our present knowledge of the conditions characterised by multiple skeletal lesions, of which the chief feature is fibrosis, certain contributions have been outstanding. It is generally agreed that the first step was made by von Recklinghausen in 1891 when among cases of various types he described two of generalised osteitis fibrosa, a condition to which his name is still attached. In 1904 Askanazy reported a case of this affection in which a parathyroid tumour was discovered after death. The next step, one of enormous importance, was made by Mandl in 1926 when he successfully removed a parathyroid tumour from a case with typical bone changes.

In this country there has been conspicuous work by three men, Donald Hunter, Turnbull and Elmslie, the first two with particular regard to hyperparathyroidism. Among several papers by these authors two may be mentioned here. In an exhaustive article on hyperparathyroidism, Hunter and Turnbull (1931) referred to the " more common " cases with multiple lesions in the bones not due to hyperparathyroidism and therefore not associated with disturbance of calcium metabolism and generalised osteoporosis. In 1933 Elmslie classified fibrocystic disease of bone as follows: 1) bone cysts; 2) osteoclastoma and osteoclastomatous cysts; 3) diffuse fibrosis of bone; 4) generalised diffuse fibrosis of bone; and 5) hyperparathyroidism. In opening a discussion on the subject in 1934 he stressed the similarity of the changes in the two types of " diffuse fibrosis," with single and multiple lesions respectively; concerning the latter group he referred to two important points—a tendency towards a unilateral distribution of the multiple lesions, and involvement of the skull in many of the cases. Though not the first to report precocious puberty associated with bone lesions, Albright and his associates in 1937 described the syndrome (now commonly known by his name) in which the multiple bone lesions are associated with areas of pigmentation of the skin and, in females, with precocious puberty. In recent years there has been a tendency to regard the two conditions—multiple bone lesions without signs of hyperparathyroidism (known to many as osteitis fibrosa disseminata) and the Albright syndrome—as one and the same. In 1938 Lichtenstein reviewed the subject, his classification being essentially the same as Elmslie's, and suggested " polyostotic fibrous dysplasia " as a suitable name for the cases of multiple diffuse fibrosis of bone without signs of hyperparathyroidism. The term has become increasingly popular in recent years and therefore has been adopted by the present writer.

There are, of course, several other conditions in which fibrosis forms a part—in some a conspicuous part—of the pathological changes in the bones. In Paget's disease, fibrosis of the marrow is the fundamental change, as it is also in leontiasis ossea, whether this occurs as a solitary affection of the skull or as one of several skeletal lesions in polyostotic fibrous dysplasia. Among other affections in which fibrosis of bone is met with may be mentioned renal rickets and osteopetrosis: it has even been reported associated with generalised thyrotoxic osteoporosis. Fibrosis of the marrow in relation to increased and decreased density of bone we discussed in 1939.

## POLYOSTOTIC FIBROUS DYSPLASIA

### Synonyms—Multiple Diffuse Fibrosis of Bone, Osteitis Fibrosa Disseminata

SUB-GROUP: ALBRIGHT'S SYNDROME

This condition is characterised by multiple lesions in the skeleton, due to fibrous dysplasia of the bones but without the general decalcification and disturbance of calcium metabolism indicative of hyperparathyroidism. In a proportion of the cases, at most one-third, there are in addition areas of pigmentation of the skin and, almost exclusively in females, precocious puberty, giving the so-called Albright's syndrome. Except that the cases exhibiting the features of this syndrome usually show more advanced changes in the skeleton than those showing nothing but the bone lesions, there is no essential difference between the two groups so far as the skeleton is concerned, and, as stated above, they are now regarded as variations of one and the same condition. Besides the papers already referred to, valuable articles have been published by Falconer *et al.* (1942), Dockerty *et al.* (1945) and Murray *et al.* (1946).

*Hereditary and familial influences*—Neither of these affect the incidence.

*Sex*—Both sexes are affected, females slightly more frequently than males.

*Age*—Though definitely an affection of childhood, it is often not recognised till much later in life. Reviewing some ninety cases collected from the literature and elsewhere, we found that in those without pigmentation the age at which the first signs appeared was ten years or younger in about one-half, the youngest being two years. In those showing pigmentation, with or without sexual precocity in addition, the age of onset was ten years or younger in two-thirds, the youngest being four months old. Many of the older cases had very long histories.

**Etiology**—Many suggestions have been made as to the causation, but none has been generally accepted. The difficulty is to find a common cause not only for the apparent endocrine error and for the bone lesions, but also for the tendency of these lesions to be unilateral, in some cases at any rate. Many feel the fundamental error must be congenital, and the hypothalamus is suspected as the seat of the primary fault by several authors. In the small number of cases in which signs have developed after icterus neonatorum, blame for the bone changes has been placed on the liver, which is said to have failed " to store and utilize vitamins " (Braid 1939).

**Distribution of the bone lesions**—The number of bones affected varies considerably: there may be only two or three or there may be many. Cases with only a single bone affected were excluded from our series, with one exception. This was a male of ten years with a large area of pigmentation on the back and with the left femur the only bone affected by fibrosis (Dockerty *et al.* 1945). Three additional monostotic cases displaying pigmented patches have been published, one by Jaffe (1946) and two by Russell and Chandler (1950). Though in the cases with Albright's syndrome the bones are generally more severely affected than in the others, there are many exceptions. In rather more than half the cases in both groups, the bone lesions are predominantly, and occasionally completely, unilateral in distribution. When the lesions are bilateral, they are not symmetrical. Sometimes they are almost or completely monomelic: this limited distribution we found in one case in every seven of those without pigmentation and one in ten of those with the Albright syndrome. The bones affected are particularly the major long bones, and the proximal bones more than the distal. Of the individual bones the femur is affected in almost every case: the humerus, tibia and fibula, radius and ulna, metacarpals, metatarsals and phalanges are all frequently the seat of lesions. In the hand it is common to find two or three metacarpals affected, the other bones being normal: a similar irregular distribution is seen in the foot. The skull is affected in about one-third of the non-pigmented cases, and in two-thirds of the pigmented: the changes are indistinguishable from those designated leontiasis ossea. The pelvis, vertebrae, tarsal and carpal bones, sternum and mandible are affected less frequently. A case with changes in

both clavicles, some ribs and cervical vertebrae, in addition to the skull and mandible, has been reported by Gemmell (1935).

**Signs and symptoms**—The onset is insidious. Attention may be called to an affected bone by a variety of incidents, such as a fracture, the appearance of deformity due to either bending or local enlargement of a bone, or the development of asymmetry of the face and skull. Pain and stiffness in a limb are less common initial symptoms. Minor trauma may precede the development of deformity without causing a definite fracture. Progressive deformity and shortening of a limb may be observed later. Only exceptionally is an affected bone longer than its fellow. When changes in the skull, face or jaw occur, exophthalmos and even gross displacement of an eye may gradually develop. Asymmetry of the face may progress till hideous or grotesque deformity is produced. Nasal obstruction may be complained of when the facial bones are affected. Pain is not a prominent symptom as it is so often in hyperparathyroidism, nor does the patient feel ill and feeble as he so commonly does in that condition.

The changes in the bones and the resulting deformities usually progress slowly until skeletal growth ceases, when there is commonly a definite halt. If both legs are severely affected the patient may be permanently crippled.

*Albright's syndrome*—Though, as already stated, Albright's syndrome is met with usually in the more severe cases, it has often been recognised in the very young when the bone changes were still in an early stage of development, or even confined to one bone. In the series reviewed we found that about one-third of the cases exhibited signs of the syndrome, but, since these are more likely to be recorded than cases with bone lesions only, this proportion is probably too high.

*Pigmentation*—Pigmented areas are practically always seen in these cases, both sexes being affected. The areas are smooth and without local thickening of the skin. Common sites are the lower back, buttocks and thighs. The size of the areas varies considerably, but they may be large. They exhibit a slight tendency to occur on the side of the chief osseous lesions.

*Sexual precocity*—This is almost exclusively found in the female patients who exhibit pigmentation, and in them it is rarely absent. An exception was a girl of eighteen years with pigmentation and skeletal precocity but without sexual precocity (Falconer *et al.* 1942). The earliest age at which signs of sexual precocity have appeared is four months (Freedman 1932): in three other cases it was apparent by the third year. In males sexual precocity is usually absent, but signs of this have been seen in a few cases (Lange 1938, Falconer *et al.* 1942, Warrick 1949—two cases). A lad of sixteen displayed female characteristics as regards his voice, development of the breasts and pubic hair (Moehlig and Schreiber 1940), but there is no mention of pigmentation in this report.

*Skeletal precocity*—This is more common than sexual precocity. The children grow too fast and appear tall for their age, but premature fusion of the epiphyses occurs and growth ceases too early, with the result that their permanent height may be below the average. Most of the women exhibiting the full syndrome are short in stature.

*Blood examination*—In most cases the calcium and phosphorus levels are normal. The serum calcium may be a little high, in spite of the absence of general decalcification of the skeleton. The cholesterol is in normal amounts as a rule and has been high only in a few cases (Snapper 1949). The alkaline phosphatase may be normal but is frequently high, particularly after a fracture. The excretion of calcium in the urine is normal. Traces of Bence Jones albumose and of albumin were present only in one typical case of Albright's syndrome (Murray *et al.* 1946).

**Radiographic appearances**—The changes in the bones are seen in the shafts and metaphyses. Only rarely do the epiphyses show changes; after they have fused to the shafts they may exhibit some irregularity of density or mottling, or the lesions in the shafts may extend into them. The lesions are essentially endosteal in origin and vary considerably in appearance. There may be only a small lesion, somewhat cyst-like, or perhaps two separate lesions of this

type, without distortion of the surface of the bone; at the other extreme there may be complete involvement of the whole shaft which is both enlarged throughout and deformed, and perhaps shows signs of old or recent fractures. A case with exceptionally severe changes in the bones was recorded by Bradfield (1931). The part of a shaft showing fibrotic changes may be sharply marked off from the rest, which is normal. It is common, for example, in the upper part of the femur, to see the shaft enlarged and showing only a thin cortex, the density for the most part being uniform except for a few scattered patches of increased or decreased density. The ground glass appearance with uniform medium density so typical of diffuse fibrosis is frequently seen in the metatarsals and metacarpals, the shafts of the affected bones being somewhat enlarged. Only occasionally is there a local fusiform enlargement containing clear areas strongly suggestive of cysts. An enormous loculated " cyst " of a rib has been reported by Jaffe (1946). Subperiosteal or cortical cysts, not infrequently seen in hyperparathyroidism, are distinctly rare. Sometimes increase in density is the chief feature; usually, but not invariably, this is accompanied by some enlargement of the shaft. The density often ends in three or four broad streaks towards one or both extremities of the bone. The larger and more extensive lesions, accompanied by deformity, are seen typically in the upper half of the femur, though also met with in other major long bones. Occasionally the fibrotic portion of a bone displays a mottled appearance. An important point to keep in mind is that the unaffected bones or parts of bones are normal in appearance and density. There is an absence of the intense generalised osteoporosis seen in hyperparathyroidism; a mild degree of osteoporosis may be seen, but only in a case that has been severely crippled for some months.

Skeletal precocity may be apparent in cases with pigmentation, and premature fusion of the epiphyses may occur.

In the skull the changes also vary considerably. The commonest change, especially in the early stages, is local thickening with irregular mottled increased density. Commencing in the maxilla, the malar region or elsewhere in the cranium, the changes gradually spread. Islands of sclerosis occur here and there and increased density is common at the base. Only exceptionally are cyst-like holes seen in the calvarium, and even more rarely do blister-like cysts form on the surface. There is no generalised decalcification. The changes are frequently unilateral, particularly in the early stages, the orbit and maxilla on one side only being affected. Occasionally the whole vault, base, and facial bones are involved (*vide* leontiasis ossea). Gemmell's case, already referred to, was exceptional because it showed increasing thickness of the inner rather than the outer table over a period of years, with apparent reduction in size of the cranial cavity.

**Progress**—As a rule the changes are progressive, especially in the more severe cases, but they tend eventually to be arrested as skeletal growth ceases. Though further extension may come to an end, the abnormal areas of bone do not consolidate but remain as weak spots in the limbs. Delayed increase in size of a lesion occasionally happens, even in middle life: in one case the increase was rapid (Jaffe 1946).

**Complications**—Fractures are common but unite readily. Thyroid enlargement may be present in severe cases, and exophthalmic goitre has been reported in a few, being associated with basophilic adenoma of the pituitary in one case (Sternberg and Joseph 1942). Acromegalic features and severe failure of vision were present in two cases reported by Falconer *et al.* (1942). Arterio-venous aneurysms occurred in one case (Stauffer *et al.* 1941). In another very remarkable case, a man of fifty-seven years, soft tissue tumours, which were cystic and apparently similar to ganglia, were associated with widespread cystic changes in the bones, including the skull, all the lesions being on one side (White 1942). Sarcoma developed in an affected bone in two cases (Coley and Stewart 1945). Osteogenic sarcoma of a tibia, with other bones showing fibrosis, was reported by Jaffe (1946). This author also reported paraplegia developing in middle life in a case of polyostotic fibrous dysplasia in which the spine was

affected. The present writer published a fatal case of renal rickets in which several bones, including the skull, showed diffuse fibrotic lesions: no parathyroid tumour was discovered at autopsy (Fairbank 1939).

**Pathology**—The essential change is the replacement of bone by relatively avascular fibrocellular tissue. This change occurs in two forms. In one the bone is replaced by yellowish or greyish-white fibrous tissue, sometimes speckled with red, and containing some gritty bone; in the other form all but a thin shell of cortex is replaced by fine-mesh cancellous tissue in which the spaces are filled by fibrous tissue. Precisely similar changes may be present when only a single bone such as the femur is affected by fibrosis. The density of the fibrous tissue varies considerably, from soft and cheesy to very dense. Many whorls of fibroblasts are seen in most cases (Valls *et al.* 1950). Though the fibrous tissue contains a considerable amount of bone it can be cut readily with a knife. The younger the lesion the greater the number of fusiform spindle cells in the fibrous tissue, the older lesions being less cellular. Though the cortex is absorbed from within, osteoclasts are few and osteoclastomata are very seldom seen—an important difference from the condition found in hyperparathyroidism. Osteoblasts are present, and there is a varying amount of new bone formation. Osteoid tissue and irregular areas of woven bone are formed as they are in hyperparathyroidism and in Paget's disease. Cartilage is seen occasionally, more often in the later stages (Elmslie 1935). Cysts, if present at all, are usually small, and are the result of degeneration. Apart from noticeable scarcity of osteoclasts, the histology in these cases differs from that in hyperparathyroidism in the absence of survival of some of the original trabeculae, and of the haphazard arrangement of the fibre bone trabeculae (Robb-Smith, in Falconer *et al.* 1942). A few, but only a few, foam cells have been found at sites of degeneration in typical cases, and these were regarded as secondary (Lichtenstein and Jaffe 1942, Dockerty *et al.* 1945). Foam cells were found in a girl of seventeen years displaying the typical Albright syndrome (Sanchez-Lucas and Freixa 1949). The difficulty of distinguishing cases of fibrosis from lipoidosis has been stressed by Snapper, who pointed out that, because the foam cells in lipoidosis may be gradually swamped by the fibrosis, it is advisable to select reasonably young lesions for histological examination: he now admits that the finding of foam cells does not exclude a diagnosis of polyostotic fibrous dysplasia (Snapper 1949). The changes in the skull are those seen when there are no lesions elsewhere in the skeleton, that is, in the cases usually designated leontiasis ossea: there is fine-mesh cancellous bone with diffuse fibrosis of all the marrow spaces. In Paget's disease the fibrous tissue is less dense and more myxomatous, and may be extremely vascular with many osteoclasts present: the new trabeculae show a greater tendency to a mosaic arrangement.

The pigmented skin is normal except for an excess of pigment, found chiefly in the basal layer but occasionally in the granulosum. Haemosiderin may be found in the reticulo-endothelial cells. In a few severe cases some enlargement of the parathyroid glands has been found: this enlargement was regarded as secondary; it was not accompanied by generalised osteoporosis.

**Diagnosis**—When there are only one or two lesions present the diagnosis may be difficult or impossible without biopsy, but as a rule it is easy. From the cases which do not display the typical Albright syndrome, *hyperparathyroidism* may be distinguished by the age of the patient—it is uncommon in childhood—by the high serum calcium with negative calcium balance, the generalised osteoporosis and the renal lithiasis, besides which pain is a far more prominent feature and the patient often feels ill and weak. *Xanthomatosis* may be difficult to exclude. In Hand-Schüller-Christian disease the clear punched-out lesions in the skull are typical: in the fibrosis cases clear holes or patches in the skull are uncommon and never as sharply defined as in lipoidosis. The diagnosis from *melorheostosis* may be somewhat difficult when the fibrosis is associated with increased density, perhaps ending in streaks in one metaphysis, and the distribution of the fibrosis happens to be monomelic. Patches of intensely

dense bone in the hand or foot should settle any doubts in favour of melorheostosis: the changes caused by fibrosis in the extremity of a limb are usually of the ground glass type and equally characteristic.

*Paget's disease* should give rise to no difficulty unless the skull is alone affected: the honeycombed appearance of an affected long bone, the obvious new bone formation on the surface, and the characteristic pointed extremity of the spreading lesion should remove all doubts as to the diagnosis.

*Eosinophilic granuloma* usually affects one bone only, but multiple lesions have been reported (Platt and Eisenberg 1948, Ponseti 1948). *Tuberous sclerosis* may affect a major long bone, but this is quite exceptional (Ackermann 1944).

In *neurofibromatosis* bone changes somewhat similar to those described in this chapter, particularly increased density in the shaft of a long bone with or without cortical cysts may be seen, but the diagnosis should not be difficult. Thannhauser (1944) considers that the two conditions, multiple diffuse fibrosis and neurofibromatosis, are related.

## REFERENCES


Ackermann, A. J. (1944): American Journal of Roentgenology and Radium Therapy, **51,** 315.
Albright, F., Butler, A., Hampton, A., and Smith, P. (1937): New England Journal of Medicine, **216,** 727.
Albright, F., Scoville, B., and Sulkowitch, H. W. (1938): Endocrinology, **22,** 411.
Askanazy, M. (1904): Arbeiten auf dem Gebiet der pathologischen Anatomie und Bakteriologie aus dem pathologisch-anatomischen Institut zu Tübingen, **4,** 398.
Bradfield, E. W. C. (1931): British Journal of Surgery, **19,** 192.
Braid, F. (1939): Archives of Disease in Childhood, **14,** 181.
Coley, B. L., and Stewart, F. W. (1945): Annals of Surgery, **121,** 872.
Dockerty, M. B., Ghormley, R. K., Kennedy, R. L. J., and Pugh, D. G. (1945): Archives of Internal Medicine, **75,** 357.
Elmslie, R. C. (1933): Liverpool Medico-Chirurgical Journal, **41,** 171.
Elmslie, R. C. (1934): Proceedings of the Royal Society of Medicine, Section of Orthopaedics and Section of Surgery, **27,** 973.
Elmslie, R. C. (1935): St Bartholomew's Hospital Reports, **68,** 147.
Fairbank, H. A. T. (1939): British Journal of Surgery, **27,** 1.
Falconer, M. A., Cope, C. L., and Robb-Smith, A. H. T. (1942): Quarterly Journal of Medicine, **N.S. 11,** 121.
Freedman, H. J. (1932): American Journal of Diseases of Children, **44,** 1285.
Gemmell, J. H. (1935): Radiology, **25,** 723.
Hunter, D., and Turnbull, H. M. (1931): British Journal of Surgery, **19,** 203.
Jaffe, H. L. (1946): Bulletin of the New York Academy of Medicine, **22,** 588.
Lange, K. (1938): Zentralblatt für Chirurgie, **65,** 2368.
Lichtenstein, L. (1938): Archives of Surgery, **36,** 874.
Lichtenstein, L., and Jaffe, H. L. (1942): Archives of Pathology, **33,** 777.
Mandl, F. (1926): Zentralblatt für Chirurgie, **53,** 260.
Moehlig, R. C., and Schreiber, F. (1940): American Journal of Roentgenology and Radium Therapy, **44,** 17.
Murray, R. C., Kirkpatrick, H. J. R., and Forrai, E. (1946): British Journal of Surgery, **34,** 48.
Platt, J. L., and Eisenberg, R. B. (1948): Journal of Bone and Joint Surgery, **30-A,** 761.
Ponseti, I. (1948): Journal of Bone and Joint Surgery, **30-A,** 811.
Recklinghausen, F. von (1891): Virchow's Festschrift. Berlin: Georg Reimer.
Robb-Smith, A. H. T. (1942): see Falconer *et al.*
Russell, L. W., and Chandler, F. A. (1950): Journal of Bone and Joint Surgery, **32-A,** 323.
Sanchez-Lucas, J. G., and Castell Freixa, M. (1949): Chirurgia del Aparato Locomotor, **6,** 45.
Snapper, I. (1949): Medical Clinics on Bone Diseases. New York: Interscience Publishers. 2nd edition, p. 223.
Stauffer, H. M., Arbuckle, R. K., and Aegerter, E. E. (1941): Journal of Bone and Joint Surgery, **23,** 323.
Sternberg, W. H., and Joseph, V. (1942): American Journal of Diseases of Children, **63,** 748.
Thannhauser, S. J. (1944): Medicine, **23,** 105.
Valls, J., Polak, M., and Schajowicz, F. (1950): Journal of Bone and Joint Surgery, **32-A,** 311.
Warrick, C. K. (1949): Journal of Bone and Joint Surgery, **31-B,** 175.
White, E. H. (1942): Surgery, **11,** 607.

## LEONTIASIS OSSEA

### Synonym—Hyperostosis of Skull

This somewhat rare condition is characterised by hyperostosis of the facial and cranial bones. The name was suggested by Virchow (1864) because the thickening of the skull may produce a leonine appearance similar to that caused by soft tissue swelling (leontiasis) in some cases of leprosy. The literature on the subject is somewhat confusing since apparently identical changes in the skull have been reported under various titles, and Paget's disease may produce somewhat similar changes; individual cases may be labelled differently by different observers. The essential change is diffuse fibrosis combined with new bone formation (hyperostosis). The thickening of the affected facial bones occurs both on the surface and towards the air sinuses, but in the cranial bones the thickening is practically confined to the outer surface. The inner surface of the calvaria may be slightly distorted and wavy, but, in most cases, shows little change.

*There seems no reason for regarding leontiasis ossea occurring alone as different and distinct from the hyperostosis of the skull seen in many cases of polyostotic fibrous dysplasia.* When in this latter condition the distribution of the changes in the limb bones is more or less unilateral, skull thickening if present occurs on the same side. Asymmetry of the face is by no means uncommon in these cases. It may be recalled that the skull is affected in about one-third of the cases of polyostotic fibrous dysplasia without pigmentation and in two-thirds of the cases exhibiting the so-called Albright syndrome. It may be assumed, particularly of the earlier reports, that in many cases of leontiasis ossea the skeleton was never searched for other lesions.

Eden (1939) classified benign fibro-osseous tumours of the skull into four groups, two of which he designated " localised fibrous or spongy osteomas " and " diffuse osteomas or hyperostoses " respectively. Apparently the only real difference between these two types is that in the localised variety the changes are confined to a single bone, and show no tendency to invade adjacent bones, whereas in the diffuse osteomas there is no limit to their spread. His other two groups—ossifying fibroma and compact osteoma—display no resemblance to leontiasis.

There is something to be said for the view that leontiasis ossea should be regarded as a term for a " clinical picture " rather than as a disease or clinical entity.

Knaggs (1923) made an extensive study of the museum specimens and early records in this country and divided the cases of leontiasis into two groups—1) creeping periostitis, and 2) diffuse osteitis. The second group Eden regards as the same as his diffuse osteomas or hyperostoses. Knaggs, while regarding this group as a form of " osteitis fibrosa," emphasized the " complete absence of periosteal bone deposits," yet he added that the bone is enlarged, often enormously, but " the enlargement gives the impression that the bone is swollen." There is no doubt, however, that in cases of leontiasis which on section show fibrosis there are often local swellings and thickenings which it is difficult to believe are not due to new bone formation on the surface: many of them, even though not so advanced, are in fact strongly suggestive of the cases figured by Knaggs as examples of his first group. Sections of a bone thickened by " creeping periostitis " showed fine-mesh cancellous bone not only in the new subperiosteal bone but also in what had been the original bone. There does not appear to be any account of the soft tissues that filled the spaces in the hyperostotic bone in these cases collected by Knaggs. In one case the hyoid and one fibula were affected: the fibula, which was enormously enlarged, was examined microscopically after death, but no report was given of the contents of the marrow spaces. We have no definite information whether or not diffuse fibrosis was present in these cases.

We are not convinced there is a material difference between Knagg's two groups, although one is more diffuse and smooth than the other. In his second group he includes four cases in which the whole skull was more or less uniformly thickened, the appearance being strongly suggestive of Paget's disease at the first glance. In one of these cases in which changes were

also present in the mandible, a femur, a tibia and the pelvis, the thickness of the cranium amounted to three inches: the patient died of sarcoma at the age of twenty-one years (Stack 1900). One skull was estimated to be that of a child of five or six years of age. In another case, a woman who died at the age of twenty-seven, the changes in the skull had been present since the age of ten. There can be no possibility that these cases are explained by Paget's disease. Most cases of leontiasis, including those in which the presence of fibrosis has been actually proved, are distinctly suggestive of the " creeping periostitis " group, in which the histological reports are incomplete.

To sum up, we believe that Weber (1924) was justified in speaking of leontiasis ossea as " localised osteitis fibrosa of the face," and we are prepared to regard this as true of all cases —not only of some of them as Knaggs apparently thought. The evidence that it is not a form of Paget's disease is overwhelming. Goundou, a condition of symmetrical protrusion of the cheeks, met with in West Africa and associated with yaws, appears to be an allied condition.*

Since leontiasis ossea not infrequently forms part of a more generalised affection of the skeleton the following points may be noted: *Hereditary and familial influences* play no part in the incidence. Wilcox (1932) reported a patient, a woman of twenty-eight years, whose father and brother were said to have had osteopoikilosis. *Sex*—Both sexes are affected with no obvious preponderance of either. *Age*—It is an affection of childhood and youth but, as it may pursue a slow course for twenty years or more, cases may be met with in middle age and even later. In some cases the onset is delayed till middle life.

**Etiology**—The cause is unknown; infection from the nasal sinuses has of course been suspected in some cases, but this certainly cannot explain the majority. Moreover the typical changes are devoid of the signs of inflammation. Injury has preceded the onset in some cases, as it has occasionally the fibrotic changes in other bones in polyostotic fibrous dysplasia, but this cannot be accepted as the true cause. Eden regards the hyperostosis as a benign tumour—as neoplastic rather than dysplasic.

**Distribution**—The bones most often affected primarily are the nasal, the malar, the maxilla just below the orbit, the mandible, and the frontal and parietal bones. The alveolar processes of both jaws and the palate may be affected. At first the changes are unilateral and often remain so for years, but in the later stages they may be widespread, even to the extent of involving the whole skull. The density of the base is frequently increased. Only rarely is the occipital bone specially affected as in the case published by MacRae (1949). Changes in one or more of the upper cervical vertebrae have been noted in a few cases (Gemmell 1935, Ruppe 1929, Burger and Lehman 1944).

**Signs and symptoms**—A common first sign is asymmetry of the face or head. Nasal obstruction may be an early symptom calling for radiographic examination. Obliteration of one or more air sinuses is usual sooner or later. Chewing may be difficult because the articulation of the teeth is disturbed. Exophthalmos and displacement of one eye in various directions is common when the hyperostosis has been present for some years. In the later stages the distortion of the features may be grotesque. Though it may be painless, pain is not infrequently an early symptom: pain may be transient, paroxysmal or continuous. The skin may be tightly stretched over a bony prominence. Pressure on cranial nerves may occur, particularly the optic nerve, with loss of vision. If the base of the skull is involved, deafness or facial palsy may develop. Inverted sleep from pituitary disturbance has been reported. In the later stages cramps, delirium and even mental disturbance may occur.

*Blood examination* shows normal findings, but plasma phosphatase may be above normal.

**Radiographic appearances**—In the vast majority there is increased density, usually irregular and mottled, but occasionally almost uniform, and obvious thickening of the affected bones. Sometimes the mottling is coarse and approaches the familiar appearance typical of Paget's disease. Only occasionally are clear areas seen, suggestive of cystic change,

* Editorial note: See also the article on " Cherubism," in this issue.

and even more rarely are these seen on the surface, looking like blisters. The frontal and other sinuses are usually invisible. As already stated, in most cases the outer table is chiefly affected, the inner showing little if any change. Windholz (1945) reported the case of a woman of sixty-three years with what he considered to be signs of both osteoporosis circumscripta and leontiasis; the fibrotic changes characteristic of the latter condition were confirmed by biopsy.

**Progress**—As a rule the condition is slowly progressive for many years. A history extending over forty-six years was reported by Kirkland (1941). Growth may be arrested ultimately: when the onset has been early it may cease to extend when skeletal growth ceases (Eden 1939). As in the other skeletal lesions that occur in polyostotic fibrous dysplasia, growth may be dormant for years. In a boy with the whole skull thickened, and changes in other bones, films taken after an interval of three and a half years showed definite increase in the thickening of the inner table, while in the outer table there was little if any further change, a reversal of the usual course followed by the hyperostosis (Gemmell 1935).

**Pathology**—Sections reveal fine-mesh cancellous spongy bone both forming the hyperostosis and replacing the bone beneath it, but as a rule leaving unchanged the inner table of the skull. All the spaces in the cancellous bone are filled with cellular fibrous tissue. Signs of active absorption of old bone and replacement by new, largely of the woven type, are usually to be seen. Calcium spheroids may be present in the fibrous tissue (Eden 1939). There is not the same tendency to a mosaic arrangement of the new bone as in Paget's disease.

**Complications**—Malignant change has been reported once only, a fibro-sarcoma growing in the naso-pharynx of a patient with generalised thickening of the skull, and which had been present for at least seven years (Stack 1900). Kirkland reported a man of fifty-four with grotesque deformity of the head, who in addition to kypho-scoliosis had multiple rodent ulcers.

**Diagnosis**—Paget's disease is the most frequent alternative diagnosis. In this disease the skull is more likely to be diffusely and smoothly thickened, whereas in leontiasis the thickening is usually more localised and protuberant. Leontiasis typically affects the facial bones though the cranium is by no means exempt, whereas in Paget's disease the cranium is the site of election, the facial bones being invaded only in exceptional cases—in not more than 8 or 9 per cent (Eden 1939). In Paget's disease the skull is more coarsely mottled with larger, woolly, dense spots. The age of the patient may be an important or decisive factor, while the nature of any changes present elsewhere in the skeleton should point strongly to the correct diagnosis.

The presence of pigmentation and a history of precocious puberty in Albright's syndrome would also be decisive. Meningiomas may cause local hyperostosis, asymmetry of the face and exophthalmos (Rowbotham 1939). Hyperostosis frontalis interna, which occurs almost exclusively in females and is associated with obesity and a variety of cerebral disturbances, should not be difficult to distinguish, since it is the inner table of the skull alone that is thickened, the very part that is usually unaffected in leontiasis.

## REFERENCES


Burger, R. E., and Lehman, E. P. (1944): Surgery, **16,** 542.
Eden, K. C. (1939): British Journal of Surgery, **27,** 323.
Gemmell, J. H. (1935): Radiology, **25,** 723.
Kirkland, G. K. (1941): British Journal of Surgery, **29,** 74.
Knaggs, R. L. (1923): British Journal of Surgery, **11,** 347.
Macrae, D. J. (1949): British Medical Journal, **i,** 389.
Rowbotham, G. F. (1939): British Journal of Surgery, **26,** 593.
Ruppe, C. (1929): Presse Médicale, **37,** 508.
Stack, E. H. E. (1900): Bristol Medico-Chirurgical Journal, **18,** 316.
Virchow, R. (1864): Die Krankhaften Geschwülste. Berlin: A. Hirschwald. **2,** 21.
Weber, F. P. (1924): Proceedings of the Royal Society of Medicine, **18,** Clinical Section, 1.
Wilcox, L. F. (1932): American Journal of Roentgenology and Radium Therapy, **27,** 580.
Windholz, F. (1945): Radiology, **44,** 14.

**CASE 20—POLYOSTOTIC FIBROUS DYSPLASIA**

(Figs. 50 to 57.) Male, aged nine years. Admitted to hospital with vague history of getting tired quickly, especially so since suffering from a combination of infectious diseases eight months before. Limping for previous two years. One year previously radiographs revealed changes in the left femur. Healthy-looking boy. Many very small pigmented spots scattered over the face, body and limbs. Thickening of trochanteric region of left femur, upper part of left tibia, and first metatarsal of left foot. Second and third toes of right foot longer than corresponding toes on opposite foot; the heads of metatarsals prominent. Left leg at least half an inch longer than right, mostly due to tibia. Circumference of left thigh and calf greater than those of right. Complete radiographic examination revealed typical changes of varying density, mostly, but not exclusively, in the bones of left leg. Bones affected were: left femur, tibia, first metatarsal (which was elongated) and its corresponding phalanges. In the right leg the upper part of femur, the second and third metatarsals and their phalanges showed changes. Special features were the increased density at several spots, particularly in the left tibia, the striated or streaky appearance in this bone and in the femur near the knee joint, and curious dense lines in the upper third of this femur. No definite changes found in the skull or the upper limbs. There was no generalised decalcification of the skeleton. Serum calcium was slightly raised, varying from 11·0 to 12·5 milligrammes per 100 cubic centimetres, but complete examination of the calcium metabolism gave normal results. Blood examination otherwise negative. Biopsy of left femur and tibia revealed diffuse fibrosis of the marrow; there was some myxomatous change, and a few small cysts were seen here and there.

Radiological re-examination five years later showed a little extension of the changes. In the upper part of both femora the appearance was more suggestive of cystic changes and more of the neck of the left femur was involved. Deformities in the left femur and tibia showed some increase: they were corrected by osteotomies. Later a pathological fracture occurred at the mid-shaft of the femur, at the site of pronounced cystic change. At the age of seventeen the lesions were even more cystic in appearance, especially so in the left femur; extension of the changes into the inner condyle and possibly into the head of this bone were seen. (For the later history and radiographs we are indebted to Mr Norman Capener.)

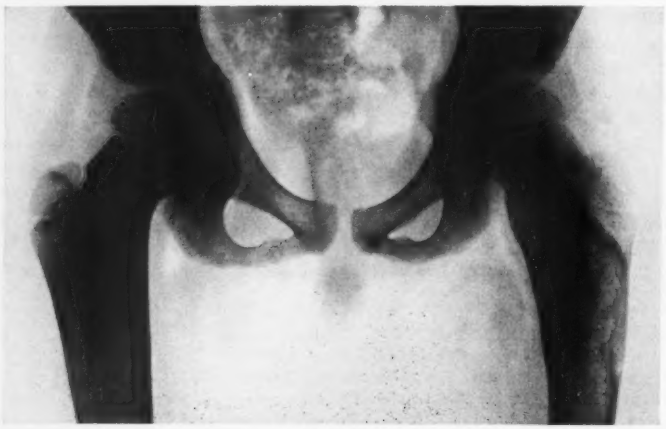

FIG. 50

Case 20—Pelvis and hips, at nine years, showing increase in size and abnormal texture of the upper thirds of both femora. The appearance is typical, with the exception of the curious strands of increased density in the left femur.

FIG. 51

Case 20—Knee joints at nine years, showing enlargement of the shafts of the left femur and tibia, and increased density of these bones ending in streaks in the metaphyses.

FIG. 52

Case 20—Tibiae and fibulae at nine years, showing the distribution of the increase in size and density in the left tibia.

[*Left*] FIG. 53 [*Right*]

Case 20—Feet at nine years, showing enlargement and textural changes in certain bones. Note the excessive length and breadth of the left first metatarsal and corresponding phalanges, and similar changes in the phalanges of the second and third toes of the right foot. The shafts of the second and third metatarsals of this foot are enlarged, but show no excess in length.

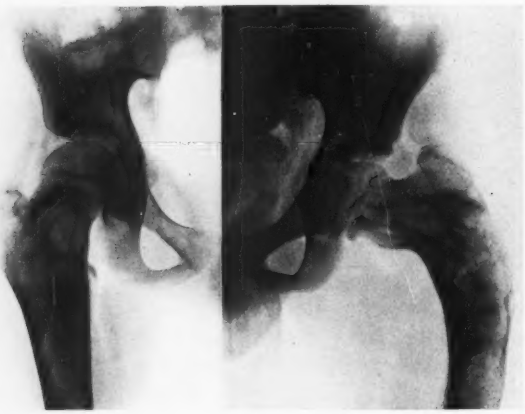

FIG. 54

Case 20—Hips at fourteen years, showing that the changes in the femora have become more cystic in appearance; the left femur has developed a deformity.

FIG. 55

Case 20—Left femur at fourteen years, showing "cystic" changes in middle of the shaft, the site of a pathological fracture later.

FIG. 56

Case 20—Left knee at fourteen years, showing more curvature of the tibia and well-marked striation of the femoral and tibial metaphyses.

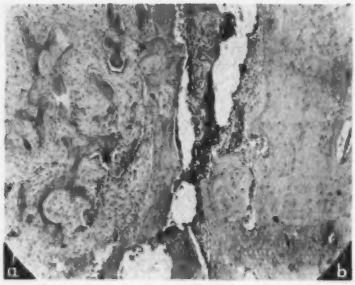


FIG. 57

Case 20—Section of left femur, showing (*a*) irregular cancellous bone with all marrow spaces filled with cellular fibrous tissue, (*b*) dense cortex. (Magnification, ×40.)

**CASE 21—POLYOSTOTIC FIBROUS DYSPLASIA (Unilateral distribution, with leontiasis ossea)**

(Figs 58 to 64.) Male, aged six and a half years. A lump on left side of head and some proptosis of left eye noticed for previous nine months. Child nervous and anaemic. Hard swelling of skull in left temporal region: not tender. Family history negative. Radiographs of the skull showed increased density and slight thickening in the left temporal and malar regions and of the left maxilla. In 1922 biopsy by Mr (now Sir Lancelot) Barrington-Ward. Fragment of bone removed was cancellous and fairly hard. Section showed fine cancellous bone with fibrosis of the marrow and numerous spindle cells and a few giant cells, indicating leontiasis ossea. Radium was inserted on two occasions. Blood examination negative. Serum calcium 11·2 milligrammes; phosphorus 3·18 milligrammes per 100 cubic centimetres. Phosphatase slightly raised. Further radiological investigations showed lesions in left arm and leg, involving the humerus, third, fourth and fifth metacarpals, some proximal and middle phalanges, femur, tibia and fibula. No generalised osteoporosis. Progress in the bone lesions was more obvious in the skull than elsewhere, and by 1926 the increase was marked; the left eye had become more prominent. The left forearm bones still appeared free from lesions and the hand showed little change. By 1933, at the age of seventeen years, there were further striking changes in the skull, and the deformity of the face was gross: the left eye was displaced forwards and downwards, fortunately without interference with vision. In addition to the frontal and anterior part of the parietal the occipital had become involved. The upper parts of the skull were mottled. In the left arm the radius and ulna now showed cystic changes with some sclerosis. Affected bones in the hands showed some advance in the changes but no additional bones were involved. In the leg the lesions also showed advances: the three middle metatarsals and their corresponding phalanges were now affected.

FIG. 58

Case 21—Skull at six years, showing early thickening of the left malar and temporal regions; there is increased density involving the left maxilla. The appearance is typical of early leontiasis.

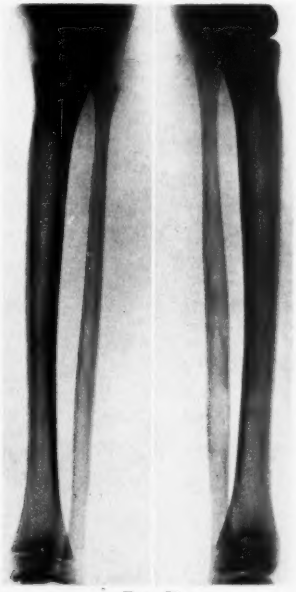

FIG. 59

Case 21—Legs at six years, showing early changes in left tibia and fibula—diffuse irregular sclerosis in tibia, enlargement and cyst-like changes in fibula.

FIG. 60

Case 21—Antero-posterior view of skull at seventeen years, showing considerable extension of the changes, no longer confined to the left side; there is greater irregularity in the density of affected bones. (Compare with Fig. 58.)

FIG. 61

Case 21—Lateral view of skull at seventeen years, showing irregular increased and decreased density of affected bones, including the left maxilla. Note involvement of the occipital, and absence of the frontal sinuses.

FIG. 62

Case 21—Forearms at seventeen years, showing the "cystic" changes, without enlargement, in the shafts of the left radius and ulna and irregular increased density in the left humerus.

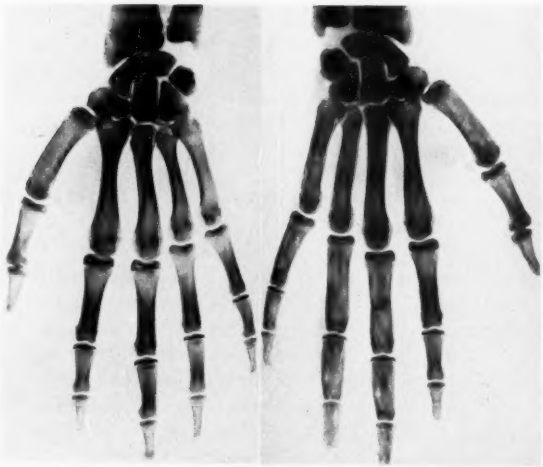

FIG. 63

Case 21—Hands at seventeen years showing, in the left, enlargement and a variety of changes in density of the three inner metacarpals and their phalanges. Note that the carpus, thumb and first finger of the left hand and the whole right hand are normal.

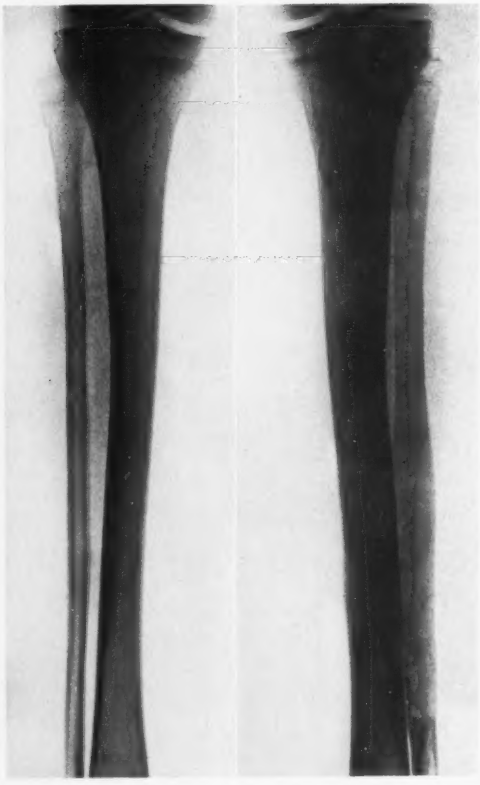

FIG. 64

Case 21—Legs at seventeen years, showing enlargement of the shafts of the left tibia and fibula, with a mixture of cyst-like areas and increased density. Note the absence of signs of osteoporosis in the right leg.

**CASE 22—POLYOSTOTIC FIBROUS DYSPLASIA (Unilateral distribution)**

(Figs. 65 to 68.) Girl, aged twelve years. At the age of three years she fell and broke her right femur; no other fractures. Right femur found thickened after recent fall on hip; radiographs revealed the dysplasia, with partial fracture, of this bone and lesions in several other bones in the right arm and leg. No asymmetry of the face or skull, but there was a suspicion of increased density in the right malar region in an antero-posterior radiograph. Right leg one-quarter of an inch short. Blood examination: leucocytes 9,400 per cubic millimetre; lymphocytes 45·5 per cent. Serum calcium 11·1, 11·4 and 10·2 milligrammes per 100 cubic centimetres on three occasions. Plasma phosphorus 4·76 milligrammes per 100 cubic centimetres. Phosphatase 1·03 (normal by this technique, 0·25). Complete investigation of calcium metabolism showed some excess of calcium in the urine, and also, though less marked, in the faeces; the excess was not considered sufficient to justify immediate exploration of the parathyroids, an opinion kindly confirmed by Dr Donald Hunter.

Three years later the case was again investigated, deformity of the femur having increased. Serum calcium was 10·7 milligrammes, plasma phosphorus 2·8 milligrammes per 100 cubic centimetres. Investigations of the calcium balance gave normal results.

Eldest of four children. No bone dysplasia in other members of family. Most of males in father's family were said to have cataract, in some cases congenital.

Bones affected were the tibia, fibula, one metatarsal, several phalanges of the foot, scapula, humerus, radius, and one metacarpal, all on the right side. The left humerus showed possible changes. No generalised osteoporosis. Biopsy of femur showed typical diffuse fibrosis. A mass of cartilage was present in a fragment taken from the site of the projection of the outer cortex; a doubtful crack is seen in the radiograph.

FIG. 65

FIG. 66

FIG. 67

Case 22—Figure 65, right humerus showing lesions of various kinds distributed through most of the enlarged shaft. Note that there is no osteoporosis of the unaffected upper end of the bone. Figure 66, right femur showing increased and decreased density distributed irregularly throughout the shaft. The projection on the outer side marks the site of a possible partial fracture. Figure 67, right tibia and fibula showing "cystic" lesions in the tibia and the ground glass appearance and uniform density of the enlarged middle third of the fibula.

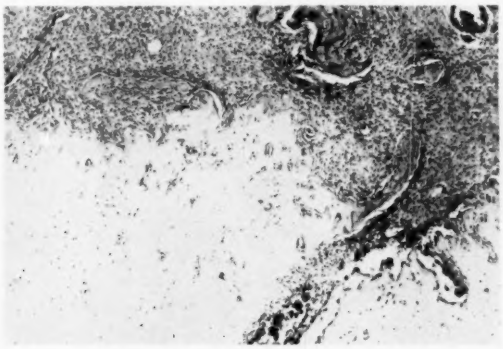

FIG. 68

Case 22—Microscopic section of fragment from femur showing typical fibro-cellular infiltration of the marrow spaces merging with a mass of cartilage, an unusual feature. (×50.)

**CASE 23—POLYOSTOTIC FIBROUS DYSPLASIA**

(Figs. 69 to 73.) Female, aged thirty-four years. Healthy till seven years old, when she broke her right femur. While under treatment in hospital for this fracture other fractures occurred in left femur, right elbow and right tibia; later she broke her left wrist. At nine and a half years had operation on right femur for deformity and imperfect union. Was treated on a frame for two and a half years. Has not walked without crutches since right thigh was broken. At seventeen years right femur became tender and two swellings developed. At eighteen years had marked deformity of both legs, and right tibia was tender and painful on bending. Neck explored but no parathyroid tumour found. She married and had one child, by Caesarean section. For some years has been unable to get about at all except in a wheeled chair, but she manages to do the cooking and even gardening from her chair. Menstruation began in seventh year. Is the third of a family of five. Others healthy. No history of fractures in family.

On admission, there was gross deformity of legs, both above and below the knees. Recent fracture of left tibia—very tender. Sits up straight in bed; spine reasonably normal. Arms and hands functionally excellent. Large pigmented areas on back and left arm. Radiological investigations at eighteen years showed diffuse changes, cystic in places, involving almost the whole of the shafts of the femora, tibiae and fibulae. Pelvis grossly deformed but showed no fibrotic lesions. Films taken at age of thirty-four years showed all the major long bones affected in the arms and legs, with the exception of both ulnae and both clavicles. Changes in the legs were far more advanced than in the arms, and included two striking features, marked diminution in calibre of parts of the femoral and tibial shafts and the presence of intensely dense patches in the bones. Changes in the humeri were more advanced than those in the radii. (Latterly under Mr H. L.-C. Wood.)

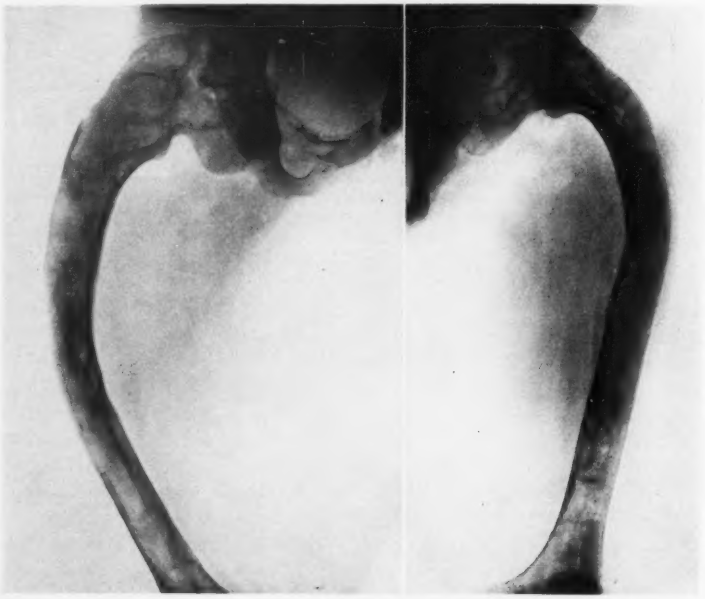

FIG. 69

Case 23—Femora at eighteen years, showing the diffuse changes in both bones and marked deformity. Note also the gross distortion of the pelvis.

FIG. 70

FIG. 71

Case 23—Figure 70, legs at eighteen years showing the difference in appearance of the tibiae. Both fibulae also show fibrotic changes. Figure 71, right knee and leg at thirty-four years, showing patches of extreme density in all the bones, with variation in calibre and gross deformity of tibia and fibula. Note that the epiphysial parts of femur and tibia are relatively free from changes.

FIG. 72

FIG. 73

Case 23—Figure 72 is a radiograph of the forearms at thirty-four years, showing fibrocystic changes in the radii but not in the ulnae. Note that the changes are much less advanced than those in the legs. Figure 73 shows the areas of pigmentation on the left arm, and the deformity of the right leg.

**CASE 24—POLYOSTOTIC FIBROUS DYSPLASIA (Limited unilateral distribution)**

(Figs. 74 to 78.) Female, aged nineteen years. Complained of pain and swelling of left ankle for past eighteen months. Minor injury to ankle six months before swelling was noticed. Family history negative. Slight limitation of movement of left ankle: not hot, not tender. Radiographs showed cystic enlargement of left lateral malleolus, and clear cyst-like changes in the inner half of the left tibial head and in the neck of the left humerus. In the tibia and fibula, but not in the humerus, the lesions involved the epiphyses which in both bones were united to the shafts. No changes in the rest of the skeleton including the skull. Serum calcium on two occasions was 10·0 and 11·1 milligrammes per 100 cubic centimetres, but investigation of the calcium excretion suggested mild hyperparathyroidism.

Operation on fibula (H.A.T.F.). Contents of "cysts" curetted out; cavity cauterised and filled with bone shavings from tibia. Material curetted out was dark red, soft and contained spicules of bone. Sections showed woven bone with all marrow spaces filled with fibrous tissue containing a few minute cysts, apparently haemorrhagic in origin. In places there was no fibre; bone and the fibrous marrow were dense and contained large numbers of osteoclasts, an unusual finding in the absence of hyperparathyroidism. Professor R. A. Willis kindly examined the section and confirmed the diagnosis. Three weeks after operation the serum calcium rose to 12·7 milligrammes per 100 cubic centimetres; the plasma phosphorus was 3 milligrammes per 100 cubic centimetres. The neck was explored but no parathyroid tumour was discovered. Two months later the serum calcium was 10·4 milligrammes per 100 cubic centimetres, the plasma phosphorus 2·6 milligrammes per 100 cubic centimetres.

Five and a half years later, radiographs showed good consolidation of the lower end of the fibula, and reduction in size, with surrounding sclerosis, of the lesion in the tibia; no appreciable change was seen in the humerus. There was no generalised osteoporosis, and the amounts of calcium and phosphorus in the blood were within normal limits. (Under Mr H. L.-C. Wood.)

FIG. 74

Case 24—Left ankle, showing cyst-like changes in the fibula involving the epiphysis as well as the metaphysis.

FIG. 75

Case 24—Left ankle showing consolidation of the cystic area in the fibula, nearly six years after operative treatment.

FIG. 76

Case 24—Left humerus showing (*left*) cystic changes at upper end of shaft, and (*right*) the same nearly six years later.

FIG. 77

Case 24—Legs showing clear areas in left tibia without distortion of the cortex. Note that the epiphysis is involved.

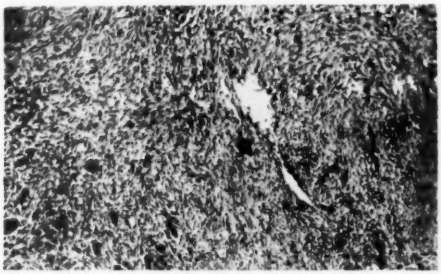

FIG. 78

Case 24—Section of biopsy specimen from the fibula, showing a mass of cellular fibrous tissue, and in part of the section a quite unusual number of giant cells. (×50.)

## ADJUSTABLE BONE-HOLDING FORCEPS

JOSE CHIRINOS, LIMA, PERU

This apparatus, photographed in two aspects below, was devised and first used in the McClosky General Hospital in Temple, Texas, U.S.A., in 1945. Different sizes are available for various bones.

The horizontal position of the forceps enables the operator to see the fracture site clearly and to apply screws and plate without obstruction. The butterfly nuts allow the superior arm of the apparatus to be adjusted for different thicknesses of bone.

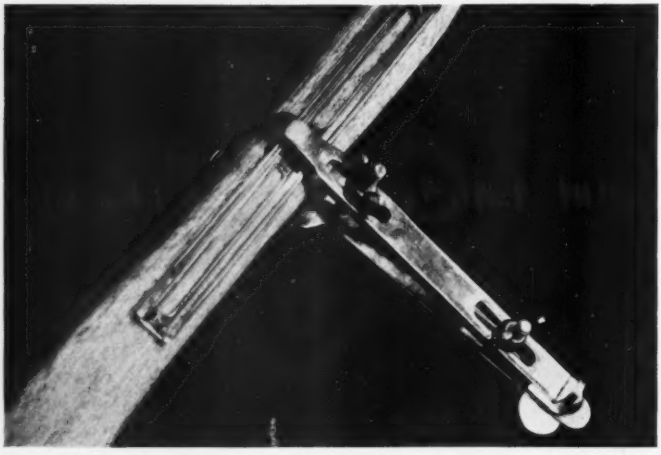

FIG. 1

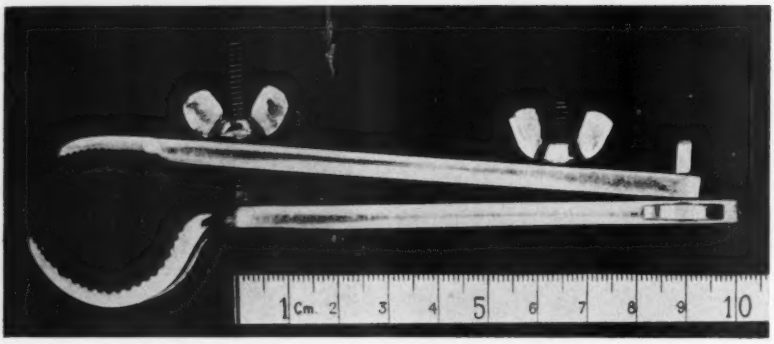


FIG. 2

Francis Glisson
1597-1677

# Francis Glisson

It is exactly three hundred years since Francis Glisson published the monograph on rickets which is justly regarded as one of the glories of English medicine. He was the son of William Glisson and was born at Rampisham in Dorset in 1597. He entered Caius College, Cambridge, in 1617, graduated B.A., later proceeded M.A., and became fellow and lecturer in Greek of his college. In 1627 he was incorporated M.A. at Oxford and soon afterwards, at the age of thirty, began the study of medicine. This was a time when interest was beginning to be diverted from the subtleties of metaphysics to physics and scientific method. In 1628 Harvey published his great revolutionary treatise *Exercitatio anatomica de motu cordis et sanguinis*, and declared that wise men must learn anatomy, not from the decrees of philosophers, but from the fabric of nature herself. Glisson graduated M.D. at Cambridge in 1634, was elected Fellow of the Royal College of Physicians the following year, and in 1636 was appointed Regius Professor of Physic at Cambridge. At the College of Physicians he lectured on anatomy, which included human, comparative and morbid anatomy. In 1640 he delivered the Goulstonian Lecture. In 1642 the great Civil War broke out; Oliver Cromwell defended Cambridge for the Parliamentarians but he was well disposed towards the University, having represented Cambridge in the Long Parliament and having been an undergraduate at Sidney Sussex College. Glisson left Cambridge soon after the outbreak of hostilities, but this could hardly have been due to military interference with his work; he was, moreover, a Presbyterian. He moved to Colchester where he built up a large private practice from a house in the parish of St Mary at the Walls. In the second Civil War the town was held by the Royalists, and in 1648 was besieged by Fairfax. Fifty-three houses were destroyed in the very parish where Glisson resided, and it was he who was chosen to be sent out to seek favourable terms of peace. He failed to obtain any concession even after two interviews with Lord Fairfax, and the defenders thereupon held out until forced to surrender through threat of starvation. After the siege Glisson left Colchester and settled in London. During previous visits he had lodged in a house in Fleet Street but ultimately took a lease of a house in New Street, Shoe Lane, in the parish of St Bride. Here he remained for the rest of his life.

In 1650 Glisson's treatise on rickets was published in London with the imprimatur of the Censors of the College of Physicians. He had patiently worked on the disease for over five years before publishing the result of his investigations under the title *Tractatus de Rachitide sive Morbo Puerile qui vulgo THE RICKETS dicitur*. The treatise was the outcome of discussion amongst seven other Fellows of the Royal College of Physicians who knew of Glisson's researches upon the malady. The preparation of the work for publication was eventually committed to the care of three of them, namely, Francis Glisson, George Bate and Ahasuerus Regemorter. Each was to contribute a part, but as the project proceeded it was found that Glisson had made such complete investigations and had written so much more than his companions that by common consent the task was left in his hands, Bate and Regemorter aiding by observation and criticism. Glisson's original description of the external appearance of a rickety child is remarkably complete: the large head, the flabby muscles, the enlargements at the ends of the long bones, the beads on the ribs, the pigeon breast and the protuberant abdomen, all are carefully recorded. Hardly a symptom of the malady escaped him; he even mentions the association with scurvy, later described by Sir Thomas Barlow. And he declared

The portrait of Francis Glisson, by an unknown seventeenth-century painter, belongs to the Royal College of Physicians, but is at present in storage at the National Portrait Gallery, London. Thanks are due to the Royal College of Physicians for their courtesy in allowing the portrait of Glisson to be reproduced.

that " this disease in its own nature is not fatal "; he was, however, able to carry out many dissections on children afflicted with rickets who had died from other causes. The following are some of his observations on the morbid anatomy of the disease:

> " 1. An irregular or unusual proportion of the parts. The head is evidently larger than normal, and the face fatter in respect to the other parts.
>
> 2. The external members and muscles of the whole body are seen to be delicate and emaciated, as though consumed by atrophy or tabes, and this (so far as we know) is always observed in those dead of this affection.
>
> 3. The whole skin, both the true and the fleshy and fatty layers, is flaccid and rather pendulous, like a loose glove, so that you think it could hold much more flesh.
>
> 4. About the joints, especially in the wrists and ankles, there are certain protuberances which, if opened, are seen to arise, not in the fleshy or membranous parts, but in the ends of the bones themselves, especially in their epiphyses.
>
> 5. The joints, limbs, and habitus of all these external parts are less firm and rigid, less inflexible than in other dead bodies, and the neck scarcely becomes rigid, *a frigore post mortem*, or to a less extent than in other cadavers.
>
> 6. The chest externally is thin and much narrowed, especially beneath the scapulae, as though compressed from the sides, and the sternum accuminated like the keel of a ship or the breast of a fowl.
>
> 7. The ends of the ribs which join with the cartilages of the sternum are nodular, like the ends of the wrists and ankles."

He also described the enlarged liver and the changes in the mesenteric glands, but the thymus he knew to be large in childhood and was not misled by it.

In the medical treatment of the disease he followed tradition and the practice of his age, discussing humors and spirits at length and indulging in an extensive pharmacopoeia which embraced the most fanciful medicaments. Before Pasteur and Hopkins the physician was as much baffled concerning the cause and cure of many of the ills of mankind as was the surgeon before Lister in the treatment of an open wound inflicted by accident or by his own hand. When Glisson is not in bondage to Galen or to traditional theories of disease, and is free to express himself at will, his ideas become distinctly more modern in colour. After studying the surgical pathology of rickets he concluded that the disease was due to disturbed nutrition by arterial blood, and he believed the changes in long bones to be due to excessive vascularity. Most of the deformities of rickets Glisson attributed to unequal growth, and, unwilling to believe that rachitic bone was more flexible than normal bone, he failed to appreciate the deforming influence of body weight, posture and contracting muscle. Thus, of rachitic scoliosis he wrote: " We compare the bones therefore in which this crookedness useth to happen to a Pillar and not unaptly . . . but if you build the pillar of more stones and betwixt every two as has been said, a wedge be interposed on one side, it will not resemble a Pillar but the proportion of a Bow." (*Philip Arnim's translation.*) And of knock-knee and bow knee he says: " This bending seemeth to be not unfitly referred to the inequality of nutrition. For if it happen by unequal nutrition, that one side of the Shank-Bone be so lengthened more than the other: Suppose outwardly, that it doth somewhat lift up the outward part of the epiphysis of the Shank-Bone (*Tibia* in original Latin) above the inward part, the joynt at the knee must needs stand outwardly bent; and on the contrary, if the inward part be lifted up, and the outward depressed, the same joynt must needs stand inwardly bent."

In a monograph by W. J. and E. M. Little on " Medical and Surgical Aspects of In-Knee (Genu Valgum)," published in 1882, it was established that deformity of the tibia was the important condition, as Glisson had taught, and not curvature of the femur as McEwan later maintained. In the surgical treatment of knock-knee he used broad padded splints of thin iron which extended along the lower limb. For children with spinal curvature he devised a sling whereby they were suspended from the head and shoulders. In bed at night, pillows were placed under the prominence to help in correcting the rotation of the vertebrae. Because he believed that the malady was due to disturbed nutrition he favoured friction, or what

to-day would be called massage: " But it is certain that rubbing doth powerfully summon the nutritive juice of the Bloody mass into the part so rubbed, therefore if at any time you rub that hollow part which is insufficiently nourished it is no wonder if it do good, being that thereby the aliment is more plentifully allured."

When Glisson began investigating rickets he shared with others the belief that the disease had but lately appeared in England and particularly in its southern counties. The word *rickets* first appeared in a Bill of Mortality of 1634 and is derived from the old English word *wrickken*, to twist. The word used in the expression " to wrick the neck," has the same derivation. Glisson suggested a technical term *rachitis*, from the Greek ῥάχις, the spine (one of the first parts affected), and because of its similarity of sound to the native word. The *Tractatus de Rachitide* passed through several editions, one of which was published in Leyden; the English translation by Philip Arnim appeared in 1651. In France and Germany the malady became known as " the English Disease."

Five years before Glisson published his comprehensive account of rickets a brief and less well-informed account of the disease was presented at Leyden as a graduation thesis by Daniel Whistler, a probationary Fellow of Merton College, Oxford, who went to Leyden in 1642 to study medicine. In 1645 Whistler published a thesis entitled *Morbo puerili Anglorum, quem patrio idiomate indigenae vocant The Rickets.* He makes no claim to originality in his essay. Some vagueness here and there in the essay, together with meagre observations on morbid anatomy, suggests a limited knowledge of the malady. It is likely that Whistler was informed of the discussions on rickets proceeding amongst the Fellows of the College of Physicians, and in this thesis he even alludes to the views of one especially learned man. It is probable that he intended no more by his thesis than to give a preliminary account of an interesting piece of work proceeding in England. The complete description and elucidation of the disease of rickets, worked out in full clinical and pathological detail and bearing the impress of originality throughout, is that contained in Glisson's *Tractatus de Rachitide.* But the earliest recognition of rickets was made by Soranus of Ephesus in his work on diseases of women; he, however, had given it no name. Soranus lived sometime at Alexandria, where he probably studied Greek medicine. He practised in Rome during the second century of our era, and his fame as a physician continued long after his day, for he was praised by both Tertullian and Augustine.

In the *Tractatus de Rachitide* Glisson describes a way of treating spinal curvature by suspending the child:

> " The artificial suspension of the body is performed by the help of an instrument cunningly made with swathing bands, first crossing the breast and coming under the arm-pits, then above the head and under the chin, and then receiving the hands by two handles, so that it is a pleasure to see the child hanging pendulous in the air, and moved to and fro by the spectators. This kind of exercise is thought to be many ways conducible in this effect, for it helpeth to restore the crooked bones, to erect the bended joynts, and to lengthen the short stature of the body. Moreover, it exciteth the vital heat and withal allureth a plentiful distribution of the nourishment to the external and first affected parts: and in the meantime it is rather a pleasure than a trouble to the child."

" Glisson's sling " became well-known on the Continent and was in frequent use at the Royal National Orthopaedic Hospital until the early years of this century; it was replaced by Fisher's suspension frame, which embodied the essential principle of the sling with less discomfort to the patient.

In his *Anatomia Hepatis*, published in 1654, Glisson gave a full account of the normal and morbid anatomy of the liver. He described the areolar tissue which surrounds the portal vein, hepatic artery and hepatic duct at the transverse fissure of the liver and its prolongation into the substance of the organ as an enveloping sheath of the branches of these structures. This sheath became known as " Glisson's capsule," a term familiar to every medical student.

In 1672 he published a philosophical treatise, *Tractatus de Natura Substantiae energetica*,

which contained an anticipation of the theory of muscular contraction. In 1677 he published his last work, *Tractatus de Ventriculo et Intestinis*, a long anatomical treatise based on some of his lectures. It is dedicated in touching language to the University of Cambridge and the College of Physicians. All his books were reprinted several times. Twelve volumes of his manuscripts, including letters, prefaces and lectures, are preserved in the Sloane Collection at the British Museum.

Glisson, to his credit, stayed in London during the Great Plague of 1665, while some of his colleagues fled with their more favoured patients. He took an active part in the affairs of the College of Physicians and was elected Censor in 1656, Harveian Orator in 1659 and President for the three years 1667–69. He was also one of those " divers worthy persons inquisitive into natural philosophy and other parts of human learning," who in 1645 initiated a weekly meeting in London to promote research in natural science. Out of this nucleus of learned men the Royal Society was formed in 1660, with Glisson as an original member. He died on October 14, 1677, eighty-one years old, at his house in New Street, and was buried in St Bride's, Fleet Street.

The *Tractatus de Rachitide* of over four hundred pages was the first monograph to appear in England dealing thoroughly with a single disease. It has aroused the admiration of all writers on diseases of children; in the words of Sir William Osler, " the entire monograph is an enduring monument to the skill and powers of observation of this great physician." It has made a peculiar appeal to orthopaedic surgeons in that it was the first complete description of a common bone disease of children and of the attempt at correction of the deformities produced by it.

ARTHUR ROCYN JONES

REFERENCES

LANGDON-BROWN, W. (1942): Chapters of Cambridge Medical History. Proceedings of the Royal Society of Medicine (Section of the History of Medicine), **36,** 17.

LITTLE, E. MUIRHEAD (1926): Glisson as an Orthopaedic Surgeon. Proceedings of the Royal Society of Medicine (Section of the History of Medicine), **19,** 111.

MOORE, NORMAN (1884): The history of the first treatise on rickets. St Bartholomew's Hospital Reports, **20,** 71.

MOORE, NORMAN (1890): Dictionary of National Biography, **21,** 437.

## GEORGE ALEXANDER RAMSAY
### 1880-1950

Dr George Alexander Ramsay, one of the best-known orthopaedic surgeons in Eastern Canada, died in Toronto on April 9, 1950, while attending a meeting of the College of Physicians and Surgeons of Ontario. Born on September 9, 1880, on a farm near the city of London, Canada, he received his earlier education there and for a few years was a teacher in an elementary school. Then, deciding to study medicine, he entered the Western Medical School (now the Faculty of Medicine of the University of Western Ontario) in 1906 and graduated in 1910. He has related that within two hours of receiving his diploma he was on a train headed for the northern wilds of Ontario, where railroad building was under way and where discoveries of gold had brought a rush of prospectors and miners.

Ramsay spent all his active medical career in the city of London, and from 1914 to 1948 was on the staff of the Western Medical School or its successor, the Faculty of Medicine of the University of Western Ontario. Beginning as an instructor in surgical anatomy he rose to be assistant professor of orthopaedic surgery in 1920, associate professor in 1932, and professor in 1939. He was chief-of-staff in surgery in Victoria Hospital, London, from 1932 to 1945, and consultant in orthopaedic surgery to other hospitals for many years. He was deeply interested and gave all his support to movements for the treatment of crippled children.

He was closely connected with the Ontario College of Physicians and Surgeons and was

President in 1926–7, as well as being a member of the committee on medical education for fourteen years. In 1948 he presented before the College a paper, "Advice to those contemplating the study of medicine," later accepted by the Ontario Department of Education for use in its Division on Vocational Guidance. His other publications dealt chiefly with technical aspects of his own field of surgery and appeared in Canadian medical journals.

With the First World War, he quickly offered his services; he was overseas from 1915–19, and saw active service in England and France as well as in Canada.

Apart from his medical interests he was throughout his life interested in literature, art and natural science. He read widely and loved to pass on to others the fruits of his study: his last act was to leave a bequest for the purchase of rare books, and books which would lead young men to high ideals in their profession.

George Alexander Ramsay was honoured in his day. He was a charter member of the Canadian Society of Orthopaedic Surgeons and a Fellow of both the Royal College of Physicians and Surgeons (Canada) and the American College of Surgeons. His own University conferred upon him the Honorary Degree of Doctor of Laws in 1948. But beyond these was the esteem of his University colleagues and the students he taught; and, surpassing all, the love which came to him from little children whose defects he had corrected, and from their parents who better understood the seeming miracles wrought by his skill.

# PROCEEDINGS AND REPORTS OF UNIVERSITIES, COLLEGES, COUNCILS AND ASSOCIATIONS

## GREAT BRITAIN

### ROYAL COLLEGE OF SURGEONS OF ENGLAND

**One hundred and fiftieth anniversary banquet**—The College is celebrating the one hundred and fiftieth anniversary of the grant of its first royal charter, and Her Majesty the Queen by accepting the honorary fellowship has already made the year a notable one. Renewing the celebrations, a company of Fellows and visitors sat down to a banquet in the college library on the evening of June 27 last.

Just before the banquet, congratulatory addresses were presented to the President, Sir Cecil Wakeley, by the spokesmen of thirty-five famous universities, colleges, companies and societies; led before the President by the vice-presidents of the College, these representatives bore names no less distinguished than the colours of their academic dress were brilliant. After the presentation of addresses the company proceeded to the library to receive H.R.H. the Duke of Gloucester, an honorary Fellow, at the banquet. Among the guests was a representative of the United Kingdom and one from each of the Dominions, chosen from among the postgraduate students of the residential college of the Royal College. These men—all young enough to have the hope of being present at the two hundredth anniversary celebration!—will cherish their memories of the occasion: one who had attended the one hundredth anniversary dinner in 1900—Sir Henry Newland, from Australia—was present, and the dinner plan, menu and toast list of the former occasion were in his hands.

Sir Cecil Wakeley shaking hands with Dr Arthur Allen before receiving from him the congratulatory address of The American College of Surgeons. Sir Harry Platt is standing with his back partly towards the camera. In the background are (left to right): Sir Gordon Gordon-Taylor, Sir Max Page, Mr Lawrence Abel, Lord Webb-Johnson, Mr A. Dickson Wright and Sir Archibald McIndoe. (There can be seen in the photograph part of the carved table-and-lectern presented to the Royal College by The American College of Surgeons.)

The Duke of Gloucester responded to the toast of " The Queen, Queen Mary, The Princess Elizabeth, The Duke of Edinburgh and the other members of the Royal Family." He reminded the company that Queen Victoria, to mark the occasion of the one hundredth anniversary, had approved of the institution of the honorary fellowship, and that on June 27, 1900, fifty years ago to the day, his grandfather the Prince of Wales, afterwards King Edward VII, had been admitted the first honorary Fellow. He assured the President that none have the prosperity and welfare of the College more at heart than those members of his family who share with Her Majesty the Queen and himself the privilege of its honorary fellowship.

The Vice-Chancellor of Cambridge, Mr S. C. Roberts, M.A., proposed " The Royal College of Surgeons of England." As Master of a college that recently celebrated its six hundredth anniversary, he had inclined to regard the College as a promising youngster, until his researches had disclosed its early beginnings in the Guild of Surgeons and the Mistery of Barbers six hundred years ago.

H.R.H. the Duke of Gloucester then accepted on behalf of the College, two gifts: an eighteenth-century silver tankard from the Royal Australasian College of Surgeons, and a medal from the Académie de Chirurgie.

In reply, the President traced the history of the Royal College from a licensing body to its present position as a centre of research and postgraduate instruction, with a valuable library and museum. Referring to future plans for the rebuilding and enlargement of the museums and departments destroyed in 1941 by enemy action, and for the erection of the Nuffield College of Surgical Sciences, he dwelt on the lack of any specific plan for the property to the west side of the College; he wondered if we might yet see the sister Royal Colleges as neighbours.

The toast " The Guests " was proposed by Lord Webb-Johnson, who confessed to some difficulty in distinguishing between hosts and guests: a great number of the guests were friends of the College of such long standing as to make them almost members of it. He referred particularly to those whose practical support had made it possible for the College to expand, and emphasized the increasing need for close co-operation between the College and the universities. Sir John Anderson, who replied, referred as a layman to the advances in modern surgery, and on behalf of the guests acclaimed the profession at whose head stood the Royal College of Surgeons of England and its sister colleges.

The two following days were marked by the exhibition in the library, council room and museums of some of the outstanding possessions of the Royal College. In the library were displayed the addresses presented on June 27, as well as books and portraits illustrating the lives and works of conservators and other officers since 1800. Some of the college plate was exhibited, including John Hunter's tankard, the Ranby Cup (1745), and the replica of King Henry VIII's Grace Cup recently presented by the Worshipful Company of Barbers.

The council room contained a selection from the original Hunterian specimens that survived the bombing of 1941, and a selection of current additions to the anatomical museum. An exhibit from the odontological museum, a display of antique instruments, and specimens from the opthalmological research unit gave this part of the exhibition a wide and varied interest.

In the pathological museum were displayed radiographs of bone, and a striking series of colour photographs illustrating diseases and injuries of modern warfare.

**Chair of applied physiology**—Dr David Slome has been appointed professor of applied physiology in the College, to take up his duties on October 1. Dr Slome, a graduate of the University of Cape Town, received his M.A. in 1926, Ph.D. in 1929, and M.B. and Ch.B. in 1930—when he was gold medallist. Later awards included the Hallett prize; he has held the Leverhulme and McKinnor Research Fellowships and has delivered the Arris and Gale Lecture at the College. He is now reader in physiology at the Middlesex Hospital Medical School, and is consultant to the London County Council cardiovascular clinic. His publications include a paper on the etiology of traumatic shock.

**Hunterian lecture**—Professor H. F. Moseley delivered a Hunterian Lecture on " Ruptures of the Rotator Cuff " at the Royal College of Surgeons on May 11, 1950. He said that his interest in lesions of the shoulder joint began while he was at St Thomas's Hospital, and he paid tribute to the inspiration he had gained from the surgeons there and later from Dr Codman in America. He preferred the term rupture of the *rotator cuff* to rupture of the *supraspinatus* because of the frequency of tears of the tendons of the other rotator muscles, including the subscapularis. It had been recognised only recently that rupture of the long head of the biceps was often associated with lesions of the rotator cuff.

Anatomically, the coraco-acromial arch was of great importance, and whenever possible it should be preserved in operations on the rotator tendons. Degenerative changes in the collagen fibres of the tendons were most marked in the " critical zone " near the insertion of the tendons into the greater tuberosity. Rupture was most common after the fifth decade, but the degenerative changes in the tendons began in the fourth decade.

When rupture was suspected it was possible to confirm the diagnosis and to assess the probable extent of the lesion by clinical tests. If abduction could not be sustained actively after injection of procaine into the area of tenderness, the rupture was extensive and probably involved more than the supraspinatus alone.

In operations for the repair of the rotator tendons a superior deltoid-splitting incision was the best. Excision of the acromion as a routine was to be condemned: it delayed recovery and often prevented a perfect result. It was his practice to remove the distal stub of tendon, make a groove in the bone of the greater tuberosity, and suture the tendon to the groove with braided silk sutures passed through holes made with a dental drill. Close contact was thus assured between the tendon and raw cancellous bone. The sutures were tied with the arm abducted and laterally rotated. After suture, the repaired cuff should be flush with the surface of the greater tuberosity. In early cases the retracted cuff was easily approximated; in delayed cases the bursa was thickened and the retraction of the tendon was more difficult to overcome. If the long tendon of biceps was frayed or damaged, its intra-articular part was removed. Ruptures of the subscapularis often went undiagnosed; they probably healed without operation. The sub-coracoid bursa had to be opened to see them; then repair by suture back to the lesser tuberosity was easy.

After operation the arm was bandaged to the side for one or two days; subsequently a sling was worn and graduated movements were begun. Complete restoration of function took three to six months.

Thirty-one out of forty-eight patients with complete ruptures for which operative repair was undertaken had been followed up. The results were assessed on freedom from pain, ability to maintain active abduction, range of movement and power, and capacity for work. In eighteen cases the rupture had been recent; of these, the result was excellent in fifteen and three were improved. In eleven cases the rupture had been of long standing: the result was excellent in one, and two were improved. The chances of successful repair were better in cases of recent rupture, but attempted repair was well justified even when the rupture was of long standing.

The lecture was illustrated by a film which showed the normal and pathological anatomy of the joint and the technique of operative repair of rotator cuff lesions.

## BRITISH ORTHOPAEDIC ASSOCIATION

The honorary Secretary announces the following arrangements: The Annual Meeting will be held in London on Thursday, Friday and Saturday, October 26, 27 and 28. The Spring Meeting next year will be held in Cambridge on Friday and Saturday, April 6 and 7, 1951.

## ANNUAL MEETING OF THE BRITISH MEDICAL ASSOCIATION

### SECTION OF ORTHOPAEDICS

This year the Association met in Southport and Liverpool; the Orthopaedic Section, with Mr Bryan McFarland as President, on July 19 and 20 gathered in the Physiology Lecture Theatre of the University for short papers, and on July 21 at the Royal Infirmary for a clinical demonstration.

The first session was devoted to a discussion of tuberculous arthritis of the hip joint. *Mr H. J. Seddon* (London) gave a brief historical review of the lines of treatment, culminating with the present satisfaction with conservative treatment followed in the quiescent stage by arthrodesis, preferably of the ischio-femoral type advocated by Brittain. There was gathering alarm, however, about the ill-effects of that prolonged rest in recumbency, which H. O. Thomas and his followers had demanded till quiescence was obtained. The lesions of the urinary tract had long been recognised, and more recently arrest of growth in the region of the knee; but the amount of demineralisation of the skeleton, and changes such as those of the thoracic cage, had received less attention. Much could be done to counter these side-effects by the balanced suspension of the whole patient and his apparatus with the system of small weights and compound pulleys developed by E. J. Nangle; but the disability of a stiff hip could not be avoided. Streptomycin gave a prospect of early arrest of the disease and some hope for the retention of useful movement in cases starting treatment before the changes had become irreversible. More than ever, early diagnosis and bacteriological proof were essential. Mr Seddon retained a high opinion of iliac gland biopsy, but if this were negative, joint biopsy should not be delayed in any doubtful case.

*Mr R. S. Garden* (Preston) discussed the points in the early diagnosis, particularly in children. He stressed the importance of loss of rotation movement as evidence of early muscle spasm.

*Mr Dilwyn Evans* (Cardiff) reviewed several aspects of conservative treatment, and mentioned the need to guard the social and psychological welfare of the patient while treatment of the affected region proceeded. Promising results from streptomycin were being obtained in the South Wales area, particularly in early cases, and few toxic effects had arisen from a dosage of 1 gram per day for ninety days. Streptomycin resistance had not been found in any of eighty cases of tuberculosis of bone and joint.

*Mr E. N. Wardle* (Liverpool) discussed the surgical treatment and the technique of arthrodesis in particular. He had a strong preference for ilio-femoral arthrodesis in children, and with a low graft placed along the upper border of the neck of the femur had obtained sound fusion in twenty-seven out of thirty-four cases. The operation was simple, it carried few risks, it could be performed without disturbing the position of the child on a Jones' double-abduction frame, and it was, he believed, preferable to Brittain's arthrodesis in children.

*Mr J. Dobson* (Wrightington) gave a detailed analysis of 320 cases treated in various ways. This paper established the regional standards by which future advances must be measured: to mention here all the speaker's points would be to anticipate full publication. Perhaps the most striking were the absence of bovine infection, the high rate of premature epiphysial fusion in the region of the knee (23 per cent of children under fifteen years), the frequency of deformity or recurrence in former patients discharged with a fibrous ankylosis, and his approval of Brittain's ischio-femoral arthrodesis for children under twelve years. Meningitis was the main cause (71 per cent) of death in children, but there appeared to be a great all-round reduction in mortality rates since therapy with streptomycin had started. The average period from the onset of symptoms to the date of diagnosis was ten months—much too long if the benefits of streptomycin in early cases were to be gained.

In the general discussion which followed, *Mr McFarland* said he was fully prepared to accept some of the arguments against the old régime of conservative treatment. Times had changed since Hugh Owen Thomas had made his necessary over-statement, and Thomas himself would no doubt be the first to recognise the altered conditions of to-day. With regard to the technique of arthrodesis, he was convinced that the osteotomy with inward displacement was an important reason for the success of Brittain's procedure. *Mr Norman Capener* (Exeter) mentioned Blundell-Jones's finding that if half a gram of streptomycin were injected into the knee joint, a useful concentration could be found up to the end of the fourth week. Small intra-articular injections at intervals of say one or two weeks might therefore be used to supplement the daily systemic dose of streptomycin. He had found Foley's technique for ischio-femoral arthrodesis, using a posterior approach, very satisfactory and free from anxiety concerning the sciatic nerve.

The main features of this session might be summarised as the disquiet excited by the side-effects of prolonged and rigid immobilisation in recumbency, the demand for early diagnosis and pathological proof of the tuberculous nature of the infection, the very cautious optimism expressed by those using streptomycin, and the approval of ischio-femoral arthrodesis in the younger age group.

On July 20 the main subject was the treatment of the short leg. Opening the discussion, *Mr Goronwy Thomas* (Liverpool) reviewed the various methods of leg equalisation, conservative and operative. The O'Connor extension type of boot, in which the foot is held in full equinus in a prosthesis which fits into a normal shoe, has a place in alleviating shortening over 4½ inches in men; fixed equinus and callosities were absent in cases where the appliance had been worn for many years. Every type of operative treatment for the long limb or for the short limb, whether during or after the period of growth, had its particular indications, complications and disadvantages. Speaking from his personal experience of tibial lengthening, he had been struck by the pressure effects on the ankle despite free lengthening of the Achilles tendon; degenerative changes in the articular cartilage and upward displacement of the lateral malleolus were common findings.

*Mr F. G. Allan* (Birmingham) gave his experience of 101 cases of leg lengthening, fifty-four of the tibia and forty-seven of the femur, using methods he has described in this Journal. No fewer than eighteen of the operations for femoral lengthening were for arrested growth secondary to tuberculosis of the hip. The average increase in length of the tibia was just over two inches, and of the femur, just under two inches; with the distraction forces under complete control, serious complications were uncommon; minimal interference with the soft tissues during osteotomy was an important factor in success.

*Mr A. L. Eyre-Brook* (Bristol) stated the case for surgical shortening. During the growth period, complete epiphysial arrest was perhaps preferable to temporary arrest by stapling; in the technique of epiphysiodesis he advocated truly extensive curettage of the cartilage remaining between the lateral bone grafts. In older patients, who could spare some height, bone shortening was safe, accurate and simple. For the femur, the bone ends could be allowed to overlap and transfixed by screws; a Blount plate was useful in the subtrochanteric region. Shortening up to four inches was followed by return of full function in the limb after three to five months.

In the discussion that followed, *Mr H. Osmond-Clarke* (London) mentioned Swedish work on the production of an arteriovenous fistula to increase the blood supply and stimulate growth of the short limb. Shortness of stature was a psychological as well as a physical handicap; he regarded five feet six inches as the critical height for men; the surgeon who performed any operation which would produce a final stature less than this was accepting a grave responsibility. Mr Seddon and Mr McFarland agreed that the judgment and skill required in the conduct of cases of leg inequality were of such a high order that patients should come under the care of one capable team in each area.

Discussing the treatment of acute osteomyelitis, *Professor W. Mercer* (Edinburgh) remarked that the main problems of to-day were those of early diagnosis, the best use of antibiotics, and the indications for surgical procedures. When the infection was diagnosed before the fifth day, penicillin alone was often sufficient; after the tenth day, surgical treatment was almost always necessary. Heroic doses of penicillin were of no great value and might even be less bactericidal; a constant blood level of 0·1 unit per cubic centimetre should be the aim. Sensitivity tests were important as resistance to penicillin might be found in 5 per cent of cases or more; in such cases he changed over to aureomycin given orally in doses of 10 to

60 milligrammes per kilogram per day. With regard to surgical measures, he refused to be dogmatic; his own preference was for incision, drilling, primary closure and splintage.

*Mr Denis Browne* (London) paid a tribute to the unpublished work of Tyrrell Gray on the closed treatment of osteomyelitis in children, and expressed his continued satisfaction with repeated aspiration of the subperiosteal abscess in this age group.

" Hidden dislocations " and other injuries which might be overlooked by reliance on routine radiographs were discussed by *Mr H. Osmond-Clarke* (London). For complete tears of the internal lateral ligament of the knee, he favoured early operative exposure and light suture before immobilisation was begun; on the other hand, conservative treatment for the torn external lateral ligaments of the ankle could restore excellent stability.

Supracondylar fractures of the humerus in children were discussed by *Mr F. W. Holdsworth* (Sheffield). The difficulties of accurate reduction had led to open operations and repeated manipulations, with bad and poor results respectively. From a review of old cases he concluded that supracondylar and dia condylar fractures were best treated by a single manipulation to reduce gross displacement, followed by simple collar-and-cuff suspension of the limb. Displaced fractures of the capitellum required simple operative replacement followed by immobilisation of the elbow in extension and pronation.

The treatment of inter-trochanteric fractures of the femur was discussed by *Mr Norman Roberts* (Liverpool). In a series of fifty cases he had in thirty-five cases performed internal fixation with a tri-fin nail and plate, which had latterly been of the McKee pattern. There was no operative mortality and he was well satisfied with the results in his selected cases.

On July 21 the clinical demonstration was held at the Royal Infirmary. Among other cases, *Mr Bryan McFarland* presented his first case of congenital pseudarthrosis of the tibia treated with a " by-pass " graft. After seventeen years the reduction of deformity and the function of the limb were quite remarkable. *Mr F. C. Dwyer* (Liverpool) presented cases of transplantation of the ulnar nerve and others of Madelungs' deformity. *Mr P. B. Moroney* showed a young patient who had sustained a " railings " fracture of the ankle; the severe adduction strain had caused premature fusion of the medial part of the epiphysial plate of the tibia with progressive deformity which required osteotomy. *Mr R. P. Osborne* (Liverpool) showed cases of tibial leg-lengthening and the use of the simple four-pin distraction apparatus made in Edinburgh. Provided a careful routine was followed and the surgeon was content with two inches of lengthening, the procedure was relatively free from pain and anxiety.

## ROYAL SOCIETY OF MEDICINE

The summer meeting of the orthopaedic section of the Royal Society of Medicine was held at the Princess Elizabeth Orthopaedic Hospital, Exeter, on June 10, 1950. The president of the section, Mr Norman Capener, was in the chair. The enjoyment of the meeting was enhanced by the delightful setting of the hospital, which was seen at its best in brilliant sunshine.

*Mr G. Blundell Jones* (Exeter) reviewed the results of the operation, described by Paul Lapidus in 1934, in which osteotomy of the base of the first metatarsal to correct the varus is performed together with correction at the metatarso-phalangeal joint. In a series of patients aged between twelve and twenty years, the initial correction of eighteen feet was good in all cases; but relapse occurred during the next two years, and the results were generally unsatisfactory. The operation was modified by the use of a lag screw between the first and second metatarsals to maintain the correction for a period of six months in a further series of twelve feet of patients in the same age group. The initial correction was well maintained in over half these cases, and all patients but one gained satisfactory improvement. Further study was necessary, however, to determine the best means of correction in the adolescent foot showing general splaying of the metatarsals. *Mr Rocyn Jones* (London) advocated a cuneiform osteotomy of the metatarsal shaft, with which he had obtained satisfactory results.

*Mr F. C. Durbin* (Exeter) showed four patients in whom transplantation of the insertion of the tibialis anterior tendon to the lateral margin of the foot had been undertaken for relapsed club-foot (talipes equinovarus). He thought the operation was indicated in children of about three to four years of age when power of active eversion was lacking. The results were better when passive overcorrection to dorsiflexion-eversion was possible; but the transferred tendon acted as a correcting factor even when some degree of fixed deformity was present. The operation had been undertaken only in neglected or relapsed cases. *Mr Denis Browne* (London) emphasized the importance of attention to detail in the use of his club-foot splint. If false correction was to be avoided, strong manipulation was needed. Active use of the muscles throughout the period of treatment was important; immobilisataion was to be condemned. *Mr K. I. Nissen* (London) thought that transfer of tibialis anterior was useful in selected cases—namely in children of four to five years of age in whom deformity had recurred and there was evidence of calf wasting and overaction of the tibialis anterior. The operation could be combined with division of the soft contracted tissues at the medial border of the foot.

*Mr H. S. Gillespie* (Exeter) reviewed thirty cases of arthrodesis of the knee and thirty-one cases of

synovectomy of the knee. The technique of arthrodesis included anterior synovectomy, denudation of the articular cartilage, and insertion of a tibial graft obliquely upwards and backwards from the upper anterior margin of the tibia to the intercondylar area of the femur. The technique had the advantage that no metallic internal fixation was used. The operation had been used mainly for tuberculous disease, and the results suggested that the method was reliable. Synovectomy had been undertaken in selected cases of rheumatoid arthritis, villous arthritis, osteochondromatosis, and benign synovial tumour. The entire synovial membrane, except that lining the posterior compartment of the joint, was excised. The patella was not removed; often the menisci were preserved. Results were assessed on the basis of movement and freedom from pain. They were best when the articular cartilage and the joint surfaces were healthy. *Mr J. Bastow* (Bath) agreed that synovectomy could give good results in selected cases. Relief of pain was often gratifying. He had observed late relapses, particularly when the operation was performed for rheumatoid arthritis. In his experience synovectomy was unlikely to be satisfactory when there was radiographic evidence of thinning of the joint cartilage. Excision of the patella—usually as a separate operation—was sometimes of value as an adjunct to synovectomy.

*Mr Norman Capener* (Exeter) discussed some of the problems of spondylolisthesis. He recalled that the pathogenesis of the lesion was not known with certainty, though many hypotheses had been put forward. He believed there was not a single cause, but several causes, including 1) derangement of the posterior articular processes—sometimes a developmental defect—permitting displacement of the whole vertebra: this was uncommon; 2) degenerative lesions of the articular processes leading to the so-called pseudo-spondylolisthesis; 3) defects of the pedicles such as might be caused by fractures. It had been mistakenly believed that, as spondylolisthesis might be associated with lordosis, attempted reduction of the displacement should be by traction in flexion. This view should be discarded: the lesion was essentially a local kyphosis and the lordosis was purely compensatory. It was reasonable to attempt reduction by traction in hyperextension. This had been successful in one of his patients, in whom previous attempts at reduction by traction in flexion had failed.

*Mr G. Rowley* (Swansea) presented a film, intended for teaching purposes, showing the early diagnosis of congenital dislocation of the hip.

*Mr R. P. Lancaster* (Exeter) had studied seventy cases of congenital dislocation of the hip treated at the Princess Elizabeth Orthopaedic Hospital. Forty patients (fifty-three hips) had been observed for two years or more and were subjected to review. There were four males and thirty-six females. Only five patients were younger than eighteen months when treatment was begun; almost half the cases were over three years of age before treatment was begun. The usual treatment had been by manipulative reduction followed by immobilisation in plaster in a position of abduction and internal rotation. Arthrography had been little used. Nine patients were operated upon: two had open reduction; six had open reduction combined with the formation of a shelf; and one had de-rotation osteotomy. Results were satisfactory in 47 per cent and unsatisfactory in 53 per cent—disappointing figures, yet comparable with most other series. Unsatisfactory results were attributed to various factors, but particularly to dysplasia of the acetabulum and to anteversion of the femoral neck. Osteochondritis of the capital epiphysis was observed in about half the cases and was seen not infrequently in the unaffected hip in unilateral cases. Satisfactory re-formation of the head was usual.

In the discussion that followed, *Sir Harry Platt* (Manchester) said that osteochondritis appeared to be commoner now than in the past. This was so even in children with otherwise normal hips. He had no adequate explanation to offer. In the treatment of congenital dislocation of the hip, open operation had recently been undertaken more often than previously. A common and striking finding at operation was a wide ligamentum teres, and sometimes an abnormally large femoral head. *Mr J. C. Scott* (Oxford) said that the true incidence of osteochondritis was unknown. Reported figures varied because surgeons accepted different standards of normality of the head as seen in radiographs. He thought that arthrography was often of value, but unless the joint was filled completely a false impression might be gained. Anteversion was important. It was difficult to measure. In suitable cases corrective osteotomy had been useful. *Mr D. Trevor* (London) stated that open reduction had been undertaken in twenty cases in a series of seventy-seven. Arthrography findings had been confirmed at operation in most cases. It was not possible to measure the degree of anteversion accurately except at operation; but rotation of 60–90 degrees demanded osteotomy. *Mr H. H. Langston* (Winchester) said that osteochondritis seemed to be as common after gradual reduction on a frame as it was after manipulation. He did not accept rotation of the neck as an important factor.

*Mr G. M. Fitz-Gibbon* (Bristol) outlined the aspects of plastic surgery that were of interest to the orthopaedic surgeon. He thought that unhealed areas were still left too long. Tiersch grafting was always worth while, even if some infection was present. If it failed the patient was no worse off, and if it was successful the gain was considerable. In designing flaps the ratio of base to length should always be adequate; the margin of safety was greatest in the head and neck, and least in the lower limbs, where the length should always be less than the base. If the flap turned blue after raising, it should be replaced in its bed and left undisturbed for three days. In avulsion injuries where a flap was torn from the surface and

had a damaged blood supply it was wise to detach the flap, remove the fat from its deep surface, and replace it as a free graft, holding it in position with a firm pressure dressing. The technique of flap grafts, including cross-leg flaps, was illustrated by lantern slides.

*Mr A. E. Jowett* (Taunton) described his experiences with the treatment of fifty-three infected bone cavities. The method used had been to saucerise the area and to fill the cavity either with vascular soft tissue (usually a muscle flap) or with bone chips. When bone chips were used the operation was done in two stages. In the first stage the saucerised cavity was lined with a split-skin graft, which was subsequently excised and the defect filled with bone chips. The use of a soft tissue flap, when available, was preferred. Healing had been obtained in thirty-seven of forty-three such cases.

*Mr Blundell Jones* discussed the possibilities of reconstruction when a thumb had been ablated or was congenitally absent. The two methods mainly used were: 1) formation of a skin tube which was subsequently filled with bone; and 2) pollicisation of the index finger. The chief disadvantage of the first method was the lack of sensation in the reconstructed digit. Two successful cases of pollicisation of the index finger were known.

*Mr Blundell Jones* had investigated the streptomycin concentration within a knee joint after local injection of the drug. A total of 5½ grammes of streptomycin had been injected into a tuberculous knee over a period of two months. The significant finding was that a considerable concentration of streptomycin within the joint persisted for three weeks after the last injection.

## INSTITUTE OF ORTHOPAEDICS

### THE BONE AND TOOTH SOCIETY

Problems of the structure and function of bone concern workers in several different sciences who have few opportunities of personal contact and exchange of ideas. Recognising this handicap, a number of interested workers from various parts of the country gathered at the Institute of Orthopaedics on March 24: the Bone and Tooth Society is the outcome of their deliberations. The Society aims at providing a discussion ground for those interested in fundamental laboratory studies on bones and teeth. An interim committee, drawn from various fields of the subject, consists of: Dr Ivor Kramer (representing dental interests), Dr C. H. Lack (clinical studies), Mr J. J. Pritchard (anatomy), Dr H. J. Rogers (biochemistry), and Dr H. A. Sissons (histology). It is proposed to hold quarterly symposia with occasional meetings for casual communications; they will take place at various centres throughout the country.

The first scientific meeting, held at the Institute of Orthopaedics on June 6, with Professor W. D. Newcomb in the chair, was devoted to a symposium on the structure of bone.

*Dr H. B. Fell* discussed the origin and developmental mechanics of the embryonic skeleton in warm-blooded animals, and described experiments relating to the origin of chondrogenic and osteogenic tissue for regeneration and regulation, and the relative importance of intrinsic and extrinsic factors in the gross anatomical development of the skeleton.

*Dr H. A. Sissons* gave an account of the microscopic structure of various types of bone as seen in the mature skeleton and in embryonic development. He outlined the cellular processes concerned in endochondral and membrane bone formation, and discussed lamellar bone, non-lamellar bone and osteoid tissue from the histological point of view.

*Dr J. J. Pritchard* described the evolution of bone structure. He discussed: 1) the comparative embryological and palaeontological evidence, very briefly; 2) the earliest appearance of bone in the geological record; 3) the question whether bone or cartilage appeared first in evolution, and the possibility of their simultaneous origin in view of the close ties between the two tissues; 4) the possible derivation of endochondral bone from membrane bone; 5) the evolution of different types of bony structure culminating in the plastic Haversian systems of large mammals (and large extinct reptiles) with special emphasis on vascular patterns.

*Dr T. F. Dixon* showed that the inorganic composition of bone varied greatly in different conditions. For example—as might be expected from the histological structure—in the same animal there were variations between one bone and another, as well as between different parts of one bone. Changes in diet caused changes in composition, and so on. From chemical and such physical examinations as X-ray diffraction patterns and differential solubility measurements, the mode of combination of the inorganic elements could be elucidated. There was still, however, disagreement as to the precise molecular composition.

*Dr H. J. Rogers* described experiments on the protein and mucopolysaccharide components of the organic matrix of bone, and gave an indication of the identity of some of the sugars present in the latter.

Those interested in the work of the Bone and Tooth Society are asked to communicate with Dr T. F. Dixon at the Institute of Orthopaedics, 234 Great Portland Street, London, W. 1.

### APPOINTMENTS

Mr Ian Macnab, F.R.C.S., a senior registrar at the Royal National Orthopaedic Hospital, will be going to Toronto in September to work with Professor R. I. Harris, and in the Department of Anatomy of the University, on anatomical anomalies of the lumbo-sacral region in relation to low back pain and sciatica.

**British Postgraduate Medical Federation Travelling Fellowship**—Mr G. L. W. Bonney, M.S., F.R.C.S., research assistant at the Institute of Orthopaedics, has been awarded a postgraduate travelling fellowship by the British Postgraduate Medical Federation. For some time past he has been particularly interested in pain mechanism in the limbs and in the control of blood supply of voluntary muscle. In order to further this work he is going to Manchester to continue it under the direction of Sir Harry Platt, Professor A. M. Boyd and Dr J. H. Kellgren. The last three months of his year will be spent visiting continental centres.

## NATIONAL INSTITUTE FOR MEDICAL RESEARCH

The new Institute of the Medical Research Council at Mill Hill was formally opened by the King on May 5. After the ceremony, His Majesty, who was accompanied by the Queen, was shown some of the work of the Institute.

The new building, which was begun in 1937 and occupied during the war by the Admiralty, has been completed and the transfer of equipment supervised under the Director, Sir Charles Harrington. It will house eight principal divisions—chemotherapy, virus research, biological standards, experimental biology, bacterial chemistry, physiology and pharmacology, biochemistry, and biophysics and optics. At Hampstead, the old building is to be known in the future as " The Medical Research Council Laboratories, Hampstead," and will contain: the tuberculosis research unit, the human nutrition research unit, the laboratory animals bureau, the laboratory section of the department for research in industrial medicine (the clinical section remaining at the London Hospital), and, ultimately, part of the environmental hygiene research unit.

The new Institute at Mill Hill (architect, Maxwell Ayrton, F.R.I.B.A.) was begun in 1937, but completion was delayed by the war. It provides about 90,000 square feet of floor space, and accommodation for four hundred workers. (*Inset*) Apparatus for freeze-drying plasma.

At a preview before the inauguration, the Director recalled some of the notable work that has been done in the Institute during its thirty years of life. He mentioned particularly the identification of dog distemper as a virus, and the method of its prevention discovered by Laidlaw and Dunlain; subsequently there was the discovery that influenza was a virus disease, and the isolation of influenza virus by Laidlaw, Andrewes and Smith. The World Influenza Centre was working in the new Institute. A team of the Institute's workers had achieved the first isolation of a vitamin, calciferol. In the field of physiology the work of the first director, Sir Henry Dale, on the chemical transmission of nervous impulses had won a Nobel prize in 1936. In anaesthesia, the use of curare and curare-like drugs had originated in the work of

the chemists and pharmacologists in the Institute. The Institute had from 1940 till the end of the war taken over responsibility for maintaining international standards for antitoxins and tuberculin, and was continuing to maintain the international standards for arsphenamines, vitamins, hormones and other drugs.

### BRITISH COUNCIL FOR REHABILITATION

Dr Henry Kessler, Medical Director of the Kessler Institute for Rehabilitation, New Jersey, U.S.A., on May 16 spoke to an invited audience on his recent world tour. Dr Kessler began by giving the estimate that 25 per cent of the world's population suffer from some physical disability. Voluntary agencies must not be daunted by the immensity of this problem seen statistically: they had in fact work to do which could not or never would be undertaken by governments. (Dr Kessler mentioned here the instance of the Japanese Government, prevented under the Potsdam Treaty from providing for the war disabled as a special category.) The example of the British miners' interest in orthopaedic care is being followed, he was happy to report, by the United Mine Workers of America, and there are indications that other United States trade unions will join them.

In introducing two coloured moving pictures of Kessler Institute patients, the speaker first stressed the necessity for treating rehabilitation as a complex whole, not as a series of independent contributions by the surgeon, the therapeutist, the technician, the limb-maker at the bench, and the patient himself. The patient, he said, lives by his residual capabilities: he must first be prepared before operation for what to expect, negatively as the result of his loss and positively from his prosthesis.

The first of the moving films showed a paraplegic ex-miner with a history of six years' immobility, after which he was suffering from bed-sores so severe that both legs had to be amputated above the knee; there were also dysfunction of the bowel and bladder, a urinary fistula, and further severe bed-sores under the trochanter. This patient was first treated in the Institute for his fistula and bed-sores, then given a thorough build-up to restore tone and strength to the muscles of arms and upper torso. He was fitted with standard-pattern artificial limbs and succeeded in learning to walk with crutches, using a swing of the shoulders to carry forward each leg. His rehabilitation was completed when he had learned how to fall and get up, and to ascend and descend stairs. The second of Dr Kessler's films showed a man with both hands amputated. After cineplasty he was able to use a simple adaptation of split hooks for playing the piano; without the hope of being able to play, this patient had declared himself uninterested in rehabilitation at all.

At the end of the address, the chairman of the executive committee of the British Council for Rehabilitation announced a new associate membership which, it was hoped, would materially help to increase the council's income.

## INDIA

### THE SOCIETY FOR THE REHABILITATION OF DISABLED AND CRIPPLED CHILDREN

The first report of the Society, which describes its work up to September 1949, begins with the unequivocal comment that the problem of the care and cure of cripples was untouched in India until March 1947. In that month and year, six doctors and a small group of helpers volunteered to organise a physiotherapy and rehabilitation clinic for the treatment of children in Bombay. Their premises a temporary hutment, the clinic's number of patients under treatment has risen from six in the first month to 122 in September 1949 (the last month reported). All cases of crippling, however caused, are accepted in the centre; but in practice the largest group has consisted of poliomyelitis cases (838 cases of poliomyelitis against fifty-one cases of spastic paralysis, the second largest group).

During 1949, educational and occupational therapy was begun, a health education committee recruited, and a surgical service arranged by renting a small ward and the regular use of the operating theatre of a nursing home; anticipating the creation of a school of physiotherapy, the medical staff began a course of lectures for masseurs to augment their previous (army) training.

The Society's report, which is printed on fifty pages of magazine size, opens with comparative maps of India and England and Wales marking orthopaedic hospitals and clinics: India has the one Bombay clinic. The tone of the report and its many illustrations convey a spirit of enthusiasm, struggle and improvisation recalling the early days of Agnes Hunt's convalescent home in Baschurch.

## AUSTRALIA

### THE AUSTRALIAN SOCIETY OF NEURO-SURGEONS

At a meeting of the Society in Melbourne on May 11, 1950, *Mr Thomas King*, by invitation, read a paper on the value of removing the medial epicondyle of the humerus and the adjacent diaphysial bone either for ulnar neuritis or for mobilisation of the nerve prior to nerve suture, arthroplasty or repair of the ruptured triceps. Just before the meeting he and his neurosurgical colleague, *Mr Frank Morgan* performed

FIG. 1

FIG. 2

FIG. 3

Figure 1—Ununited fracture of the medial epicondyle causing ulnar neuritis. Figure 2—The same elbow after epicondylectomy. Note the amount of bone removed. Figure 3—A normal elbow for comparison.

epicondylectomy on two patients at St Vincent's Hospital for nerve lengthening and for the ununited fracture of the medial epicondyle shown in the radiographs reproduced above. The late results in six patients were also demonstrated.

Mr Morgan said that Mr King and himself had performed epicondylectomy on sixteen patients. He operated from the front with the elbow extended and nibbled away the epicondyle and adjacent bone; Mr King preferred a posterior approach with the elbow flexed. The nerve need not be disturbed from its groove and there was little bleeding. Pain was less and recovery more rapid than after anterior transposition.

Several instances of increase in the symptoms and signs of ulnar neuritis after the nerve had been embedded in the flexor muscles were related. *Professor S. Sunderland* thought that this operation, by removing the distal part of the medial supracondylar ridge, dealt with the rigid inter-muscular septum which might be one cause of continued symptoms after transposition. *Mr R. S. Hooper* had tried the method twice but thought that the nerve might be injured later because it was not so well protected as in the embedding operation.

At the meeting, which was arranged by the Royal Australasian College of Surgeons, great disappointment was expressed because the Simm's Commonwealth Professor, Sir Reginald Watson-Jones, was unable to be present because of illness.

## UNITED STATES OF AMERICA

### DETROIT ACADEMY OF ORTHOPAEDIC SURGERY

On May 4, 1950, the Detroit Academy of Orthopaedic Surgery visited Toronto for the first meeting to be held outside their own city since the society's foundation. They were entertained by the orthopaedic surgeons of the Department of Surgery of the University of Toronto.

A clinical programme at the Hospital for Sick Children included contributions by *Dr Robert Wilkinson*, suppurative arthritis; *Dr R. M. Wansbrough*, Legg-Perthes disease; *Dr Wm. Mustard*, limitation of rotation of the shoulder in late Erb's palsy; *Dr Stuart Thomson*, the Denis Browne splint in the treatment of club feet; and *Dr A. B. Le Mesurier*, amputations in children. Luncheon was served at the Toronto General Hospital where the afternoon programme included presentations by: *Dr F. Preston*, the management of long-standing dislocation of the shoulder; *Dr F. P. Dewar*, treatment of fractures of the shaft of the femur with Kuntscher's intramedullary nail; *Dr H. S. Coulthard*, the technique of arthrodesis for tuberculosis of the hip; and *Dr George Pennal*, plantar digital neuritis (Morton's metatarsalgia). An orthopaedic clinico-pathological conference was directed by Dr W. L. Robinson and other members of the staff.

## BELGIUM

### THE BELGIAN ORTHOPAEDIC SOCIETY

A special summer meeting of the Society was held in Ostend on June 17 and 18, 1950. Clinical cases were shown on the first morning by the president, Dr Delcroix, at his private clinic, and by Dr Blankoff and Dr F. Parisel at the Institut Hélio-Marin at Coq-sur-Mer, where many cases of tuberculous arthritis under treatment by streptomycin were demonstrated. The high standard of radiography was noteworthy.

The afternoon was given over to the presentation of a report on the treatment of the late effects of injuries of the ankle by Drs C. Van de Voorde, A. de Wulf and E. Vereecken, a report which had already been published in the Proceedings of the Society. The following morning a number of papers on various subjects were read.

The Belgian Society of Orthopaedics, which is outstandingly active, holds regular meetings once a month and the proceedings are published very fully in their journal, Acta Orthopaedica Belgica.

Mr H. J. Seddon, Sir Reginald Watson-Jones and Mr K. I. Nissen have been elected corresponding members. If a British observer were allowed to comment, he might remark that the discussion of papers is much more formal and restrained than would be expected in this country under similar circumstances, but that this defect—if it be one—is fully compensated for by the enjoyable social nature of these meetings.

## KENYA

### THE ORTHOPAEDIC CENTRE, NAIROBI

*Mr W. H. Kirkaldy-Willis* writes:

It is hoped that before the end of the year part of our department will be moving to the top floor—this town is very dusty—of the new surgical block which is now being built to hold four hundred beds. We shall have a male and a female ward, of thirty beds each, and a first-class operating theatre and plaster room, with a dark room attached. All cases for operation will be in these wards. We are also planning to open a convalescent home somewhere near Nairobi for patients with surgical tuberculosis; but these plans are still only in the initial stages.

We are still trying slightly different methods for arthrodesis of the hip, both in osteoarthritis and tuberculosis, and we arthrodese a hip about once a fortnight. For cases of osteoarthritis we do an intra-articular arthrodesis through a modified Smith-Petersen approach, pack the joint space with iliac chips and then place an iliac graft between the ischium and femur below the joint, instead of inserting a long trifin nail. This method seems to give very good results. For patients with tuberculosis we are trying the insertion of an iliac graft and chips through the posterior approach described by Van Gorder. This seems to be less " shocking " than the anterior approach, and can be done without a blood transfusion; the exposure is in our opinion not so good as the modified Smith-Petersen approach. We hope soon to be able to review about a hundred cases of arthrodesis of the hip done here over the past five years.

Tissue plane infections and pyogenic myositis are relatively common in this country. Many patients do not come to hospital until the condition is far advanced, and it is not uncommon to see such cases with pathological dislocation due to softening of the joint capsule and ligaments. The commonest sites for dislocation are the atlanto-axial joint and the hip joint, the former caused by retropharyngeal infections and the latter by soft tissue infections round the hip.

There is almost unlimited scope in this centre for clinical and bacteriological research into inflammatory diseases affecting bones and joints. There are many cases of spinal disease here in which the differential diagnosis is difficult to make. Tuberculosis, brucellosis and osteomyelitis of the spine can all produce erosion accompanied by marked new bone formation, often under the anterior common ligament. Yaws frequently produces symptoms and signs—and a radiograph—very similar to those of tuberculosis in a joint. Osteomyelitis in this country nearly always begins insidiously, and affects the mid-shaft of long bones in nearly every case. Acute osteomyelitis affecting the end of a long bone hardly ever occurs in African patients. These problems confront us every day, but it is almost impossible either for the clinicians or laboratory workers to find the time for the necessary research. When workers are available for this task we may expect to learn a number of new and fascinating facts about the organisms causing bone inflammation in the tropics and about the way in which the bone tissue of African patients reacts to bacterial invasion.

Our " follow-up " department has now been going for nearly eighteen months under the direction of an African almoner. During the year 1949, between 85 per cent and 90 per cent of our patients reported as instructed—a figure much better than we had dared to expect. This department is also responsible for the welfare of patients in hospital, as well as after they leave us to return home.

## INTERNATIONAL SOCIETIES

### THE INTERNATIONAL SOCIETY OF ORTHOPAEDIC SURGERY AND TRAUMATOLOGY

The International Society of Orthopaedic Surgery and Traumatology, which was established in 1929, will hold its fifth Congress in Stockholm from May 21 to May 25, 1951. The *président d'honneur* of the Society is Professor Ombredanne of Paris, and the president is Sir Harry Platt of Manchester. The vice-presidents are M. Ramon San Ricart of Barcelona and M. Etienne Sorrel of Paris, and the treasurer,

M. Charles Parisel of Brussels. The secretary-general is M. Jean Delchef, 45 rue Montoyer, Brussels, Belgium. The *président d'honneur* of the Congress is Professor Waldenstrom of Sweden, the president, M. Scherb of Zurich, the vice-president, M. Sten Friberg, and the secretary of the congress, Mr Anders Karlen, Karolinska Institutets Ortopediska Klinik, Stockholm.

A discussion on "Avitaminosis and the osteopathies" will be opened by *Dr Zanoli* of Italy and *Dr Rutishauser* of Switzerland. The results of treatment in cases of low back pain and sciatica is the subject of the second discussion which will be opened by *Dr M. J. S. Barr* of Boston, U.S.A. There will be many other contributions, and, in accordance with the wishes expressed at the meeting of the delegates in Paris in 1949, members will be requested to deliver their lectures either in French or in English. The publication of the addresses, however, will be in whichever of the five official languages of the International Society the author prefers. The special attention of contributors is drawn to the fact that twenty minutes are allowed for the openers of discussions, fifteen minutes for special communications, ten minutes for contributions to the discussions that are announced before the meeting, and no more than five minutes if the discussion has not previously been announced. These times will be observed strictly.

## INTERNATIONAL SOCIETY OF INTERNAL MEDICINE

An International Society of Internal Medicine has been established under the first presidency of Professor A. Gigon of Basel, and the meetings will be held in Paris on September 11 to September 14, 1950. The International Committee of the Society includes representatives from nineteen countries. The main discussions will include contributions by *Dr Waksman* of New Brunswick on streptomycin and neomycine; by *Dr Bernard* of Paris on streptomycin; and by *Dr Dugger* of New York on aureomycin. There will be a discussion on adreno-cortical physio-pathology, opened by *Drs Luft* and *Sjögren* of Sweden dealing with clinical studies on the effect of desoxycorticosterone acetate on blood pressure and renal function, and also a communication by *Drs Lederer* and *Denis* of Louvain on the pathology of thyro-adrenocortical relations. Reports on the adrenocortico-trophic hormones of the pituitary will be presented by *Dr Thorn* of Boston and *Drs Luft, Sjögren* and *Li* of Sweden. The many other discussions include: the use of radioactive substances in internal medicine; physio-pathology of the renal circulation; new cardiovascular diagnostic methods; the role of histamine in pathology; the cellular response of the reticulo-endothelial cells of the bone marrow; experimental investigation on bone marrow function; intra-articular injection of osmic acid in painful joint affections; headache due to occipito-atlantoid arthropathy; and discussions on nutrition, avitaminosis and fluorosis. Arrangements are being made for excursions to places of interest in and about Paris. Correspondence relating to the meeting should be addressed to Professor Justin-Besancon, 38 rue Barbet-de-Jouy, Paris 7e.

## THE SIXTH INTERNATIONAL CONGRESS OF RADIOLOGY

The sixth International Congress of Radiology, the first to be held since 1937, was opened in London on Monday, July 24, by the Earl of Athlone. At the opening ceremony Dr Ralston Paterson of Great Britain was installed as President of the Congress, and messages of welcome, including one from His Majesty the King, were extended to the delegates, numbering some 2,700. The extremely full programme, which lasted for five days, consisted of scientific and technical exhibitions and of papers on all aspects of radiological technique. The papers read were grouped into four categories—radiodiagnosis, radiotherapy, biology and physics.

**Arthrography**—In the diagnostic section a symposium of considerable orthopaedic interest was held on arthrography. *Dr Hauch* (Canada) evaluated the methods of vacuolisation, pneumarthrography and the use of opaque contrast media in the examination of meniscus lesions of the knee joint. In his series of cases the most accurate results were produced by pneumarthrography. *Dr Lindblom* (Sweden), using positive contrast media as a routine, showed a large series of slides demonstrating all types of meniscus tears. *Dr Borow* (United States of America) also demonstrated the value of pneumarthrography in meniscus lesions. The use of oxygen or air appears to be the more popular in the United States and Canada, whilst the opaque medium is more frequently used in Sweden. The statistics and convincing slides shown by all these speakers was evidence that a high degree of accuracy is given by arthrograms in the diagnosis of meniscus lesions of the knee joint.

*Dr Nelson* (London) read a paper on arthrography of the shoulder joint. He showed films demonstrating supraspinatus lesions of varying severity, the appearances in frozen shoulder, and the detection of non-opaque loose bodies within the joint. *Dr Norgaard* (Denmark) discussed arthrography of the temporo-mandibular joints in which considerable accuracy has been achieved in the diagnosis of degenerative forms of arthritis in a series of nearly 200 cases.

**Vascular changes in cases of rheumatoid arthritis** were demonstrated by *Professor Leb* (Austria). Following the injection of an opaque medium into the brachial artery, serial films taken at short intervals show that vascular changes precede the typical early radiographic appearances. The peripheral arteries are seen to be narrowed or occluded, whilst there is stasis and dilatation of the terminal veins.

**Sacro-iliac changes in ankylosing spondylitis and osteitis condensans ilii**—In another group of papers on diseases of bones and joints, *Dr Knutsson* (Sweden) reviewed a series of cases X-rayed at the Orthopaedic Clinic in Stockholm between 1936 and 1949, showing changes in the sacro-iliac joints. Tuberculous, septic and neoplastic lesions were eliminated from this series and the remainder fell into two main groups: ankylosing spondylitis—147 cases, and osteitis condensans ilii—thirty-seven cases. In all but one of Dr Knutsson's cases of ankylosing spondylitis the disease was bilateral; in seven the disease was localised in the sacro-iliac joints and no spinal involvement was seen; in only one case were the sacro-iliac joints spared when the spine was involved.

In contradiction of the great predominance of males in ankylosing spondylitis, Dr Knutsson found that thirty-five females were affected in his thirty-seven cases of osteitis condensans ilii. He was not able to reach any conclusion regarding the etiology of this condition. It was stated by a later speaker that in a series of up to twenty cases he had found changes typical of Scheuermann's disease associated with those of osteitis condensans ilii; he believed that there was possibly some connection between these two lesions, and that the changes in the sacro-iliac joints might be in the nature of an osteochondritis.

**Vertebral retroposition**—*Dr Gillespie* (London) reviewed a series of 493 confirmed disc lesions, in which seventy-seven cases showed some degree of " reverse spondylolisthesis." Apart from a few cases of congenital origin, vertebral retroposition is stated to indicate the presence of a disc lesion.

**Other papers**—The papers concluded with a symposium on skeletal changes in diseases of the blood. Osseous changes in the leukaemias were fully described by *Dr Soto* (Uruguay) and *Drs Lefèbres, Lerique* and *Bertrand* (France). *Dr Drey* (Israel) showed an unusual case of Cooley's anaemia, while *Dr Cocchi* (Switzerland) made a comprehensive review of skeletal changes in cases of lymphosarcoma, myelomatosis and osteomyelosclerosis.

In the radiotherapeutic section, *Dr Morrison* (Birmingham) analysed the results of X-ray treatment in approximately 200 cases of ankylosing spondylitis. He discussed the different techniques used and assessed the value of the various forms of treatment.

In the scientific exhibition, more than eighty exhibitors showed radiographs and various instruments in therapeutic use. Collections of radiographs of bone tumours were shown by *Dr Sparks* from the Bristol Bone Tumour Registry and by *Dr Grout* (Sheffield). A collection, illustrating many aspects of bone and joint pathology, was shown by Dr Campbell Golding and Dr E. H. Allen at the Royal National Orthopaedic Hospital. In the technical exhibition over seventy firms from all over the world demonstrated their most recent apparatus.

A full social programme included a dinner at the Guildhall, a Government reception at which the Minister of Health received the guests, a performance of the ballet at Covent Garden, and finally a ball held at the Savoy Hotel.

# Book Reviews

MODERN TRENDS IN ORTHOPAEDICS. Edited by Sir Harry PLATT, M.D., M.S., F.R.C.S., Professor of Orthopaedic Surgery, University of Manchester; Consultant Adviser in Orthopaedics to the Ministry of Health; President, Société Internationale de Chirurgie Orthopédique et de Traumatologie. 10 × 7½ in. Pp. viii+497, with 222 figures. Index. 1950. London: Butterworth & Co. (Publishers) Ltd. Price 45s.

It is doubtful whether, after digesting the contents of this book, the reader will know whither British Orthopaedic Surgery is trending, but he certainly will have gained a considerable insight into its present scope and activities. The Editor has, disappointingly, restricted himself to a brief introduction but the guiding hand of the master is revealed throughout the book in the choice of contributors (thirteen in all) and in the presentation of each subject. Charnley opens with some easy riddles. The statement that " there are few to-day who would lightheartedly undertake the treatment of a fracture of the femur by the use of continuous traction alone " should, I believe, be altered to " traction by itself enables one to treat a fractured femur with a light heart." Nevertheless, Charnley's article is stimulating; one man at least in England is meditating on fractures. Girdlestone remains contented to condemn an innocent child to five years' imprisonment with immobility for developing skeletal tuberculosis. Is it not time this cruel treatment were reviewed ? Girdlestone makes amends for his complacency by an excellent account of the various decompression operations for paraplegia. Ellis writes on the difficult subject of bone and joint infections: difficult, because no one has sufficient experience of these illnesses in this antibiotic age. Rocyn Jones has nothing new to add about congenital dislocation of the hip; but then, has anybody ? Practical common sense, with a leaning towards conservatism, is the feature of McFarland's article on congenital deformities. Quite rightly he points out the importance of providing a quirk when operating on syndactyly. You must read the book to learn what a quirk is. To Capener has fallen the thankless task of writing on chronic arthritis. The toll arthritis takes on man-power has brought into being the Empire Rheumatism Council. So far the Council has been no more successful in warding off the devastating effects of rheumatic diseases than was King Canute in keeping back the sea. Barnes's excellent article on bone tumours is marred by the appallingly bad illustrations that characterise this book. Many figures resemble nothing so much as those of the pelvic fascia in Whitnall's *Astonishing Anatomy*. A publisher may be unable to reproduce radiographs satisfactorily, but it is insulting to the reader to fob him off with pictures like Figure 98 and Figure 172. Osmond-Clarke writes on idiopathic scoliosis. Though an enthusiast for fusion after correction in a Risser jacket, he points out the pitfalls and is judicious in his assessment of results. On infantile paralysis Maud Forrester-Brown writes: " It is a great mistake to say, ' That limb is hopeless, why burden the patient with a splint ? ' " Surely this is a question that we all ought to be asking ourselves all the time; it is as well that Miss Kenny was visiting behind the iron curtain when this book was published. Forrester-Brown omits to emphasise that treatment of spastic paralysis is primarily the job of the educationist, just as geriatrics is more the concern of Universal Aunts than of doctors. Birkett opens his article on spinal injuries with an admirable short history. Balancing the comparative worth of active exercises and immobilisation in treatment, he comments on the apparent lack of disability after undiagnosed fractures of the spine in epileptics. Furlong contributes a gem on tendon and muscle injuries: small, and of great price. Griffiths follows with an article on arterial lesions. Griffiths knows what he wants to say, and says it clearly and concisely. Perhaps he too lightly dismisses pressure as a cause of arterial insufficiency, in view of Army surgeons' universal belief in the value of incising deep fascia as a prophylaxis against ischaemia. The large subject of bone dystrophies has properly been entrusted to Jackson Burrows, a pupil of Elmslie; for Elmslie was one of the first to attempt to disentangle " fibrocystic disease." No better account of the bone dystrophies is to be found in English. Jackson Burrows knows his Albright, and uses the terms osteoporosis and osteomalacia in their modern sense. This article will be a joy to those of us with weak memories for epononyms.

I have read this book from cover to cover. Any book actually read by a reviewer is worth buying.—George PERKINS.

CAMPBELL'S OPERATIVE ORTHOPEDICS. Second edition. Edited by J. S. SPEED and Hugh SMITH. $10\frac{1}{4} \times 7$ in. Pp. xxiii + 1643, with 1141 figures, including 5 in colour. Index to the whole work in each volume. 1949. London: Henry Kimpton. Price £10. 10s. (Two volumes.)

The appearance of a second edition of Campbell is a great event: the original book was unique, and we look for a very high standard in its successor, especially as this is edited by men of the the calibre of J. S. Speed and Hugh Smith, who took a large part in the original work and who have called upon a distinguished band of contributors, mostly from the University of Tennessee. We can say at the onset that we have not been disappointed. The standard of Campbell's great work has been maintained.

The composition of a good book on operative surgery is fraught with a fundamental difficulty. The easy, tidy, logical way—the way the administrator would do it—is to catalogue a number of operations and to append an account of the uses to which they might be put. The clinician approaches—or should approach—operations quite differently, from the point of view of the disease or defect, the outlook and physique of the sufferer, his needs, how these can be met, and, if by operation, by what form of operation. This " real life " approach, with all the difficulties of classification it implies, was bravely chosen for this work and is at once its glory and its weakness. The book is thus almost an orthopaedic text-book, full of common sense advice about the correct choice of treatment, often expressed with agreeable wit. The operation takes a proper place as an incident in the management of the patient, and the so-called after-treatment of each operation is duly considered. Results have been recorded in some instances, but with a commendable and unusual reserve.

The original book's thousand and more pages made it very unwieldy and, now that it has grown by half, the publishers have divided it into two volumes of reasonable size with a full index to both volumes in each—an admirable arrangement. Its greater length is the consequence of more illustrations, more detail for the benefit of the trainee and the addition of new sections on such subjects as mould arthroplasty, atypical non-union, ruptured intervertebral discs, peripheral nerve injuries and amputations, and—most important—on pre-operative and post-operative care, advances which have not only made surgery safer and more effective but have widened its scope. Since the last edition, the so-called antibiotics have revolutionised much of surgery, and many problems of their use have yet to be solved. Much in the present edition concerning, for instance, the surgery of osteomyelitis and of tuberculosis is still tentative. The advice to await an evident abscess in acute osteomyelitis and to leave the wound open after drainage would produce many strong opinions but no authoritative answer. New techniques, such as the war-time developments in medullary nailing of fractures, demand and receive consideration although their full appraisal is not yet accomplished. The same is true of the modifications of epiphysial growth made possible by Blount's work with staples.

The first chapter of the first edition dealt with the physiology and pathology of the connective tissues, and served to remind the surgeon of the respect due to living things. This chapter needed rewriting, but it has gone completely; its place is taken by a chapter on pre-operative and post-operative care.

In the chapter on amputations the fingers are given the prominence they deserve and rarely get. It is a refreshing change from the procrustianism of our own monopolists to find an appreciation of the advantages of " end-bearing " stumps, particularly those just above the knee, if fitted with limbs constructed upon proper principles. The division of open amputations into circular amputations and those with flaps tends to obscure the principle that the greatest economy of tissue can usually be secured only by an irregular division of the various tissues in conformity with the conditions found; no mention is made of the surest way of preventing retraction of the skin, namely, fixing it with a few points of suture over some of the dressings; it is not quite true that an open amputation must always be followed by another amputation.

The section on injuries of the knee joint is one of the very best in the book. The anatomy and function of the joint have been reviewed in the light of modern work, and meniscus injuries have been dealt with in great detail. Not all British surgeons would agree with the conclusions of the authors about the merits of partial or complete removal of a damaged meniscus, although they advance powerful and logical arguments in favour of their views.

It is a pity to find in so authoritative a book the persistent use of the term *débridement* in the sense of scavenging; it has nothing to do with débris, but means " unbridling "—a picturesque Gallic description of the act of laying a wound freely open. This pleasant term has become so misused that nothing remains but to drop it altogether: this course we commend to the editors, as an act of leadership, though with faint hope that they will induce others to do likewise.

The task of selection must always be difficult, but a few procedures have been included which we can regard only as manifestations of irresponsible surgery. For instance, can there be any real need or justification for " immobilising " fragments of a child's radius, fractured at the neck, by transfixion with a Kirschner wire passed through the capitellum and the joint? Such a procedure is not only described but illustrated and condoned. Would any surgeon in his senses allow it upon his own child? Another form of ill-considered readiness to operate upon fractures is illustrated by a description of " intramedullary "

fixation of the clavicle with a Steinmann pin, in which a medullary cavity is freely attributed to this cancellous bone.

The Editors make apology that reference to foreign work has been curtailed by war-time interruption of the flow of literature. This is understandable, but a good many procedures of old standing have been tagged, not with the name of their originator, but with that of a subsequent re-discoverer or an exploiter; the names of Macewen, Elmslie, Fairbank and Gordon-Taylor, for instance, are not to be found; but, if we were to complain, it would rather be that some less good British work has been uncritically (or too charitably) included. Some important American work is omitted; for instance, in a discussion of skeletal tumours no mention is made of benign chondroblastoma.

The typography falls a little short of the best modern standards, but the illustrations are of the excellence that we have come almost to expect in American publications.

This work is so important that we have felt obliged to consider it from a severely critical standpoint, at the risk perhaps of failing to convey that it is a really great work, a fine achievement and a credit to the centre from which it comes. Its high price in this country makes us regretful when we say that every orthopaedic surgeon will have to get it.—H. Jackson BURROWS and H. OSMOND-CLARKE.

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X-RAY DIAGNOSIS FOR CLINICAL STUDENTS AND PRACTITIONERS. By G. SIMON, M.D., F.F.R., Assistant Radiologist, St Bartholomew's Hospital; Assistant Director, X-Ray Department, Brompton Hospital. $10 \times 7\frac{1}{2}$ in. Pp. x+207, with 180 figures. Index. 1949. Cambridge: W. Heffer & Sons Ltd. Price 20s.

I would class this as a fairly good book. It is reasonably comprehensive and well arranged; the text is very clearly set out; the illustrations are numerous and moderately well printed. But the author seems to have been undecided whether he was writing for undergraduate or post-graduate students, for general or special practitioners. Unless one were familiar with radiographs the absence of the normal appearances would render difficult the full appreciation of the abnormal; in the chest section, for instance, even one normal radiograph would be a help. There are a few details which provoke criticism. " Osteomyelitis (no penicillin) " is well illustrated but " osteomyelitis (some penicillin) " is not shown; a march fracture of a fourth metatarsal bone is not a very typical example; a supracondylar fracture of the humerus might have been included under " Elbow injuries in childhood "; the term " joint space " might be explained; somebody might have spotted " tallus " as being an odd spelling; and finally the cobbler ought to stick to his last, or in other words a radiologist ought not to give advice to students (or practitioners) on treatment and prognosis—for instance: " Healing (of stress fractures) is usually rapid and often complete in about a month " and " if after a month's observation (of a suspected tuberculous joint) the condition has resolved clinically and the X-rays are still normal, it can be assumed that the joint lesion was not tuberculous." An experienced observer will nevertheless find this book very interesting.—Bryan MCFARLAND.

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THE HINGE GRAFT OR GINGLYMUS IMPLANT. By Arnold K. HENRY, M.B. (Dubl.), M.Ch. (Hon.) (Cairo), F.R.C.S.I., Emeritus Professor of Clinical Surgery in the University of Egypt; Professor of Anatomy in the Royal College of Surgeons, Ireland. $10 \times 7$ in. Pp. viii+64, with 47 figures. Index. 1950. Edinburgh: E. & S. Livingstone Ltd. Price 15s.

Osteoperiosteal grafts are much used by orthopaedic surgeons to reinforce methods of arthrodesing joints, to block movement in others and to provide bone for filling defects. Sometimes, if used singly, the graft may break in its middle and develop a pseudarthrosis. This fact has been applied by Henry to produce what he calls a " hinge graft," enabling movement to be retained in one direction while limiting it in another. The method, which seems most unsound by modern standards, has been applied by the author to about fourteen cases (including congenital club foot, paralytic talipes equino-varus, talipes calcaneo-valgus, genu recurvatum, fractured calcaneum and spastic flat foot, as well as to the preparation of a prehensile forearm and for replacing the skeleton of a finger). Strange to say, the procedure seems to have worked—assisted, it must be admitted, by such things as tendon transplantation. The illustrations are not all convincing, but the writer's enthusiasm will carry the reader easily from cover to cover; for with Henry there is always much else worth reading besides the subject he starts you thinking about.—Norman CAPENER.

THE PATHOLOGY OF ARTICULAR AND SPINAL DISEASES. By Douglas H. COLLINS, O.B.E., M.D., Reader in Clinical Pathology in the University of Leeds. 9 × 6 in. Pp. viii + 331, with 199 figures. Index. 1949. London: Edward Arnold & Co. Price 35s.

Although there are numerous works dealing with the pathology of bone in its various aspects, there has been need for an authoritative review of the pathology of joint disease. The present admirable work goes a long way towards filling this gap and should be part of all orthopaedic libraries, both personal and institutional. As a book of instruction, it will be valuable not only to the senior student but also to the practising surgeon. It is for this constituency rather than for the pathologist that the author has catered. Although he has restricted the scope of the work, he has been obliged to give a short review of bone pathology in little more than a series of thumbnail sketches; this is necessary for an understanding of the limited field discussed and might well be expanded. As a whole the book is very well produced. The text is written in a thoughtful, easy style; each chapter has an excellent bibliography; and the illustrations are first class. A discussion of the histology and physiology of bone and articular structures precedes a short review of bone diseases, followed by chapters upon injury in relation to joint diseases, osteoarthritis, gout, infective arthritis including tuberculosis, rheumatic fever, rheumatoid arthritis, the joint lesions of endocrine and metabolic disorders, tumours of joints and, finally, several chapters on spinal diseases. Mindful that many radiological atlases exist, the author has included only a few radiographs to illustrate special points. In this we believe that a great opportunity has been missed; for, too often, orthopaedic surgeons and radiologists fail to correlate shadows with pathological substance. Where radiographic with macroscopic and microscopic anatomy of the same pathological material is illustrated, as is done in several spinal diseases, the combination is most instructive. The author could well expand this idea in the future editions that doubtless will be called for. A few statements must be criticised. "Tumours of joints are rare and therefore of greater interest to the pathologist than of importance to the clinician." Though somewhat rare, these tumours are of the greatest clinical importance, as has been shown by G. A. Bennett, the reference to whose work is incorrectly titled. "Spondylolisthesis is applied to a condition, diagnosed only by means of X-ray . . . no anatomical dissections are recorded." "Paraplegia in Pott's disease is probably never due to direct pressure by kyphotic angulation." These and other statements that could be mentioned almost always concern matters in which the author wanders from the path of his own observation. Such inaccuracies, which could easily be remedied by a clinician reading the proofs, do not, however, seriously detract from a review of articular pathology of originality and great teaching value.—Norman CAPENER.

FIG. 177
(From *The Pathology of Articular and Spinal Diseases.*)
Multiple deposits of Hodgkin's tissue in vertebral bodies with pathological fracture. The fractured body has been almost completely destroyed by the disease. The same gross picture may be seen in carcinomatosis, and the diagnosis rests on the histology and on the findings in other organs. Sagittal division of dorso-lumbar spine.

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ROENTGEN DIAGNOSIS OF DISEASES OF THE SKULL. By Max RITVO, M.D., Assistant Professor of Radiology, Harvard Medical School; Instructor in Radiology, Tufts Medical School, Boston, Massachusetts; Director, Department of Radiology, Boston City Hospital; Associate in Radiology, Beth Israel Hospital, Boston. Foreword by George W. HOLMES, M.D. 10½ × 8 in. Pp. xix + 409, with 368 figures. Index. 1949. New York: Paul B. Hoeber, Inc. London: Cassell & Co. Ltd. Price £5. 18s. 6d.

The radiological diagnosis of diseases of the skull can no more be divorced from the brain than, let us say, diseases of the myocardium can be separated from those of the endocardium. Yet text-books continue to appear in which the authors try to discuss the skull apart from all else. They say that pneumoencephalography or other contrast methods will not be discussed, but inevitably these procedures creep in, if only by the back door. If the work is honestly confined to diseases of the skull bones, no difficulty arises: but that

is too dull. The urge to describe normal and pathological calcification within the cranial cavity always becomes overwhelming, and the writers find themselves embarking on the diagnosis of diseases of the brain. Ritvo is no exception in yielding to this temptation. In the preface he states that " pneumoencephalography is not discussed . . . ", but a few illustrations appear and a short chapter is given to that other contrast method, cerebral angiography. On page 227 it is stated that air injection studies are hazardous and to be avoided whenever possible, but ten pages later a different view is expressed: " Air is almost universally used because it is harmless and disappears spontaneously." Plain X-rays, pneumoencephalography and angiography all play a vital part in modern neuroradiology and their relationship must be thoroughly understood, although all three methods need not be used in every case.

The book is liberally illustrated and includes nearly 400 skull radiographs. Unfortunately the quality of many of them is not first-class, as can be seen readily by comparing Figure 333 (borrowed illustrations) with the others. Many could have been improved by reproducing only the relevant portion of the skull, and others could have been weeded out altogether, for instance the tin tack through the parietal bone seen in two planes; these two illustrations occupy two full pages. Regarded as an atlas showing the gross morbid changes that are seen in the skull bones, the book will be interesting to an orthopaedic surgeon, especially in relation to generalised bone diseases. Quite an extensive chapter is devoted to injury. Radiography of the patient in bed by means of portable apparatus is condemned, but no mention is made of the Lysholm type of fixed grid, so useful in bedside traumatic work. The text makes only about one-third of the 400 pages, and clinical descriptions tend to be sketchy. Some of the cases described and illustrated are not confirmed microscopically. Short, rather unbalanced, bibliographies are included at the end of some of the chapters.—James BULL.

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INFECTION AND SEPSIS IN INDUSTRIAL WOUNDS OF THE HAND. A Bacteriological Study of Aetiology and Prophylaxis. By R. E. O. WILLIAMS and A. A. MILES (assisted by Barbara Clayton-Cooper and Brenda Moss). (Medical Research Council Special Report Series No. 266.) $9\frac{1}{2} \times 6$ in. Pp. 87, with 5 figures and 31 tables. 5 Appendices and References. 1949. London: His Majesty's Stationery Office. Price 1s. 6d.

This Medical Research Council report on infection and sepsis in industrial wounds of the hand is contained in a booklet of eighty-five pages. It describes the bacteriological findings in 1,635 examples of minor lacerations, compound fractures of the terminal phalanges of fingers, and small skin wounds treated in factory surgeries of Birmingham (mainly light engineering works). About 20 per cent of wounds when first seen contained staphylococcus aureus, and 1 per cent streptococcus pyogenes. The staphylococci in these fresh wounds were largely derived from the patient's own skin; it was less clear whence the streptococcus pyogenes and bacillus coli came, but the interesting observation was made that the solution of cetyl-trimethyl-ammonium-bromide used for cleansing wounds might contain bacillus coli. In septic wounds the staphylococcus aureus was much the most often found, with streptococcus pyogenes a co-partner in one-fifth of the cases and rarely found alone, and bacillus coli present in small numbers. Most of the staphylococcal infections appeared early in the history of a wound, whereas streptococcal infections were seen later and were nearly always caused by cross-infection. Sepsis in wounds of the hand was more frequent in carriers of cocci than in non-carriers, and especially so when the carrier organism was of a toxigenic strain. As the interval between injury and treatment increased from one to four hours the infection rate increased; it was higher in males. Some people are unusually subject to sepsis when wounded. Infection always delayed healing, and when the streptococcus pyogenes was combined with staphylococci the delay was very much greater. Added bacillus coli infection increased the delay but slightly.

In the prevention of wound infection, great stress is laid on aseptic technique; less important factors are occlusive dressing, the type of wound-cleansing agent, and local prophylactic agents (sulphathiazole, penicillin, etc.). Thorough cleansing of the wound was found to be more important than the type of agent used; cetyl-trimethyl-ammonium-bromide is regarded as a better agent than saline, soap and water or sodium hypochlorite, but sensitisation occasionally complicates its repeated use. A strict aseptic dressing technique greatly diminishes the cross-infection rate (*i.e.*, the incidence of streptococcus pyogenes). The repeated use of proflavine-sulphathiazole decreased wound infection, but there was danger of sensitivity to sulphathiazole.—L. W. PLEWES.

DIAGNOSTIC RADIOLOGY, For Practitioners and Students. By G. CLAESSEN, M.D., Late Radiologist to the University Hospital, Reykjavik; Lecturer to the University of Iceland. Foreword by J. W. MCLAREN, M.A., M.R.C.S., L.R.C.P., D.M.R.E. $9\frac{1}{2} \times 6\frac{1}{2}$ in. Pp. 411, with 347 figures. Index. 1949. Copenhagen: Einar Munksgaard. London: William Heinemann Medical Books Ltd. Price 60s.

The whole field of diagnostic radiology is covered in 400 pages. The description of radiological lesions in each section is therefore limited and somewhat superficial. It is, however, a balanced description, and space has been allotted according to the practical importance of the conditions. The common and important variations are described and the uncommon ignored. This principle is followed throughout; for example, the description of accessory ossicles in the foot includes only the five bones most often encountered, and these are reproduced in diagrams or radiographs. The pages on the skeletal system occupy approximately one-third of the volume. The descriptions of obstetrics and gynaecology and of the urinary system are relatively short: less than one page is devoted to tumours of the kidney. The book would serve as an introduction to radiology for the student at the beginning of post-graduate study. It would also help the medical student or general practitioner, but one may doubt whether many have time to read volumes in special subjects. The translation has been done extremely well; the text is lucid and without ambiguity; the illustrations, in the form of positive prints, are clear and well reproduced.—F. Campbell GOLDING.

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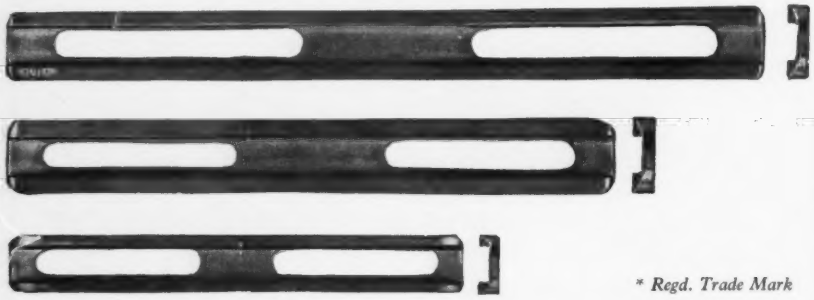

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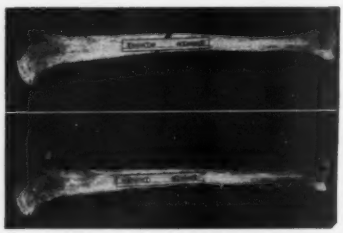

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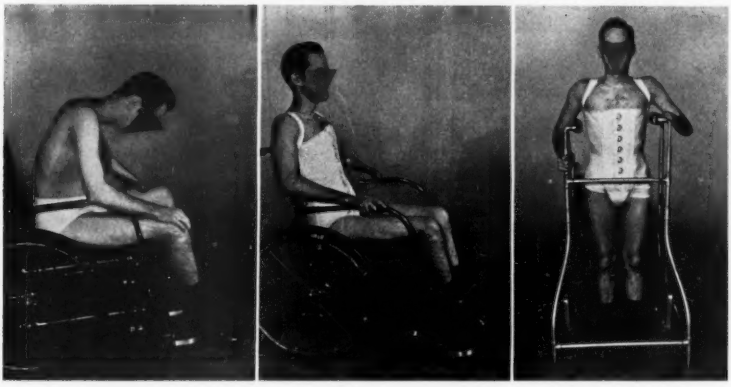

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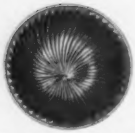

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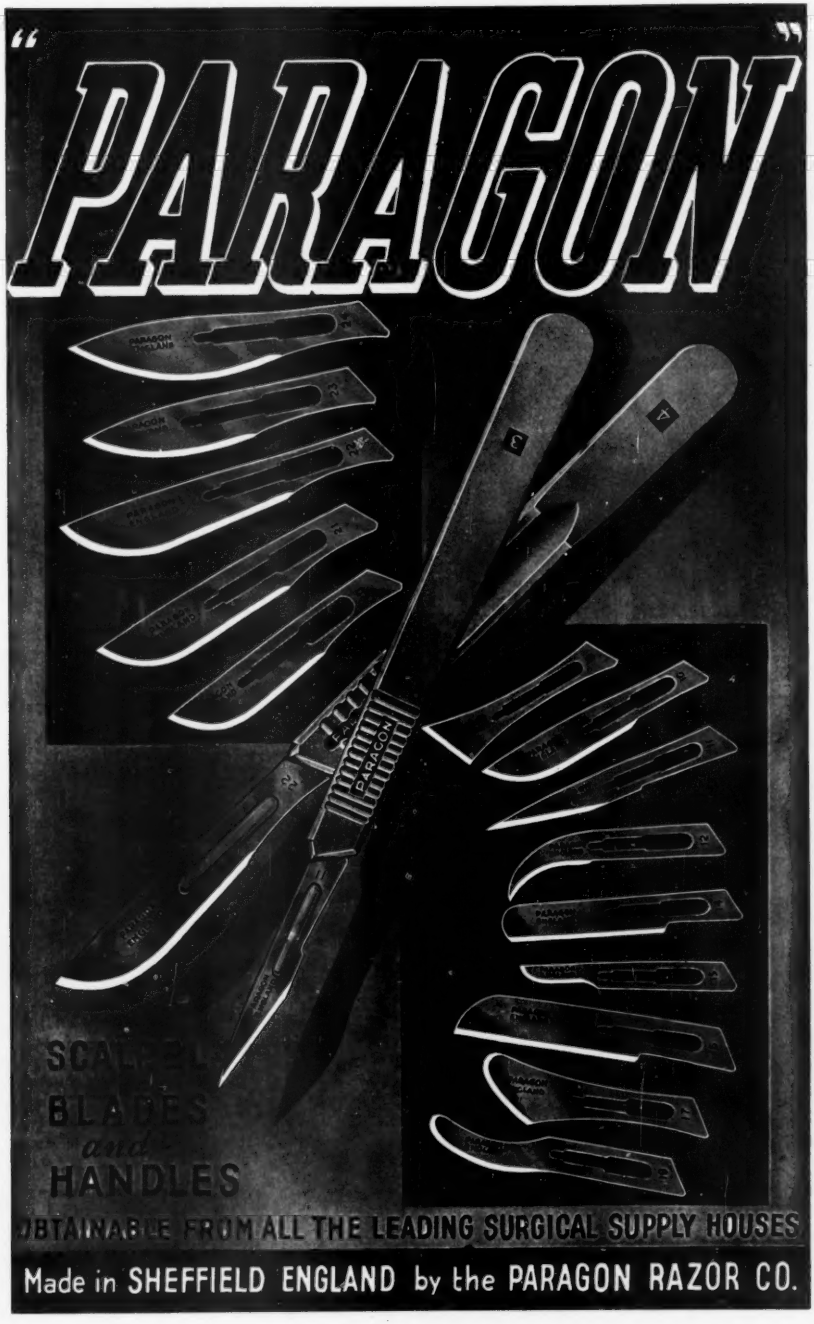
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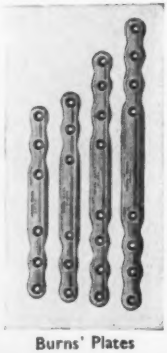

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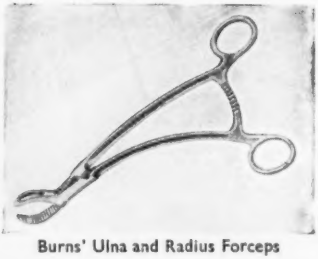

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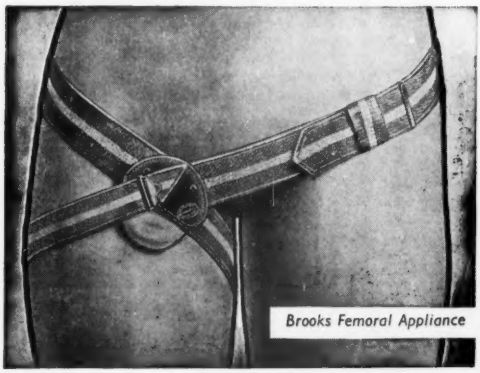

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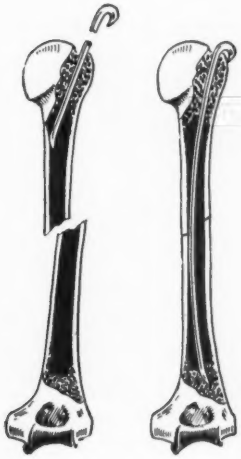

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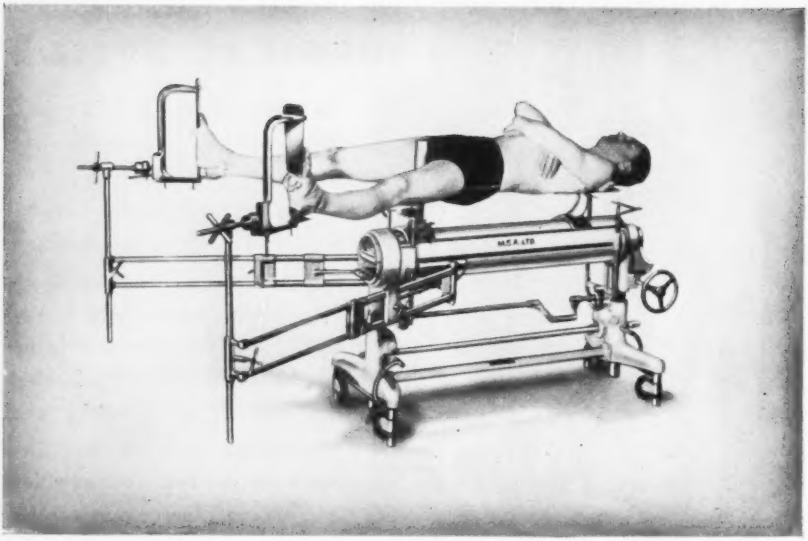

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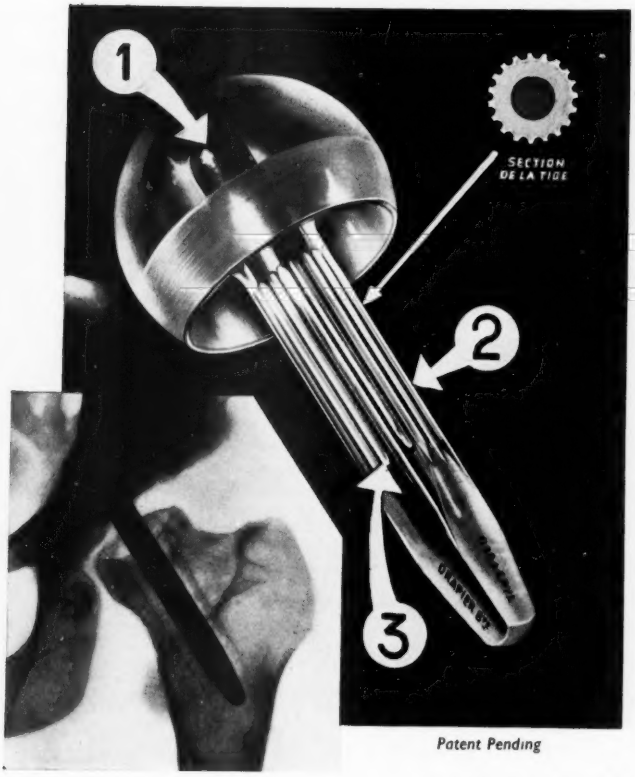


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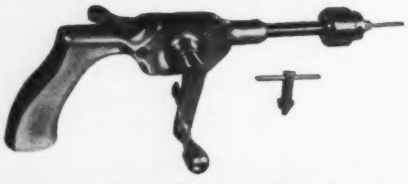

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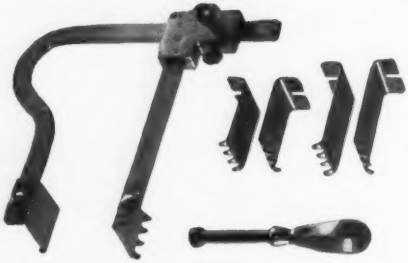

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